【書類名】　図面

Fig. 1

図1 全体ブロック図

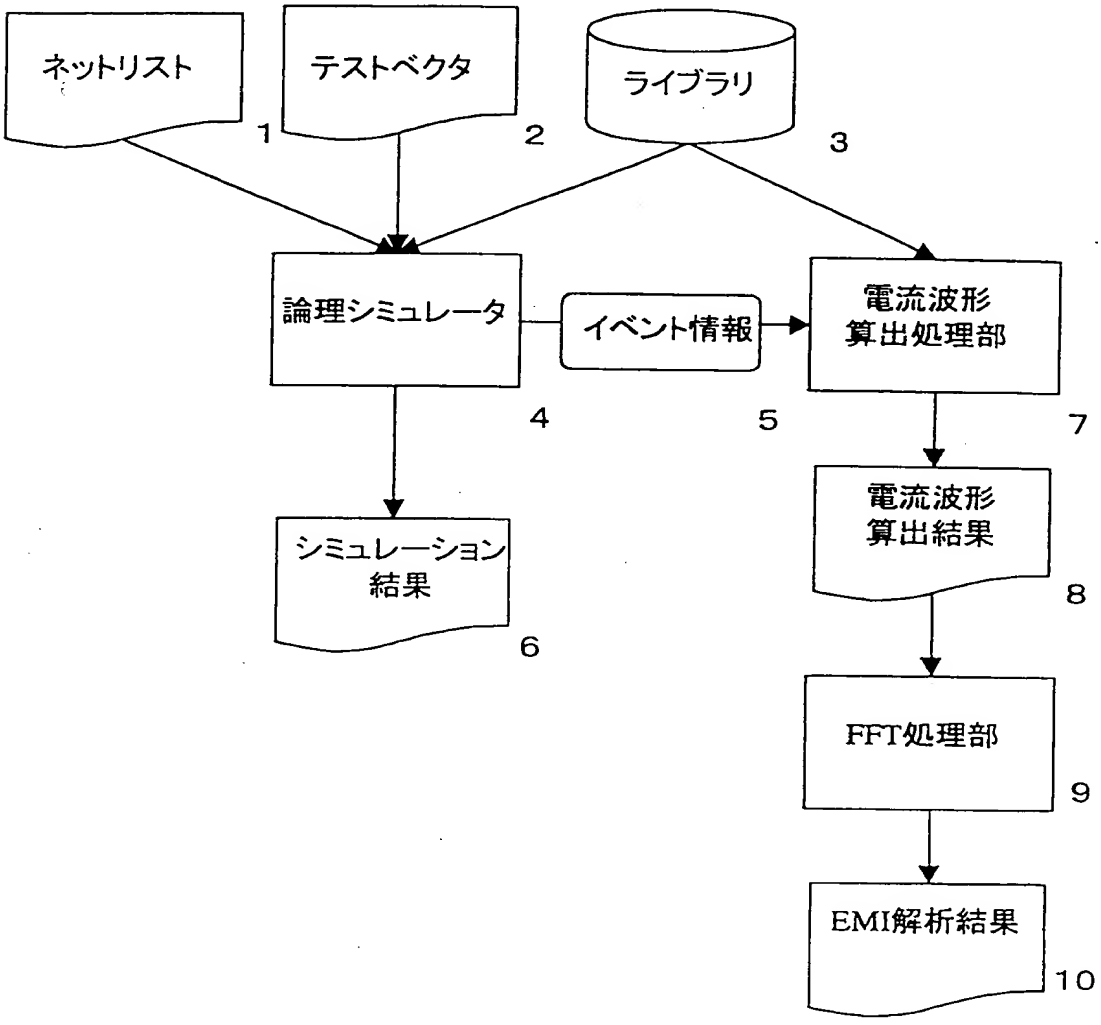


Fig. 2

図2電流波形算出処理
ブロック図(実施形態1)

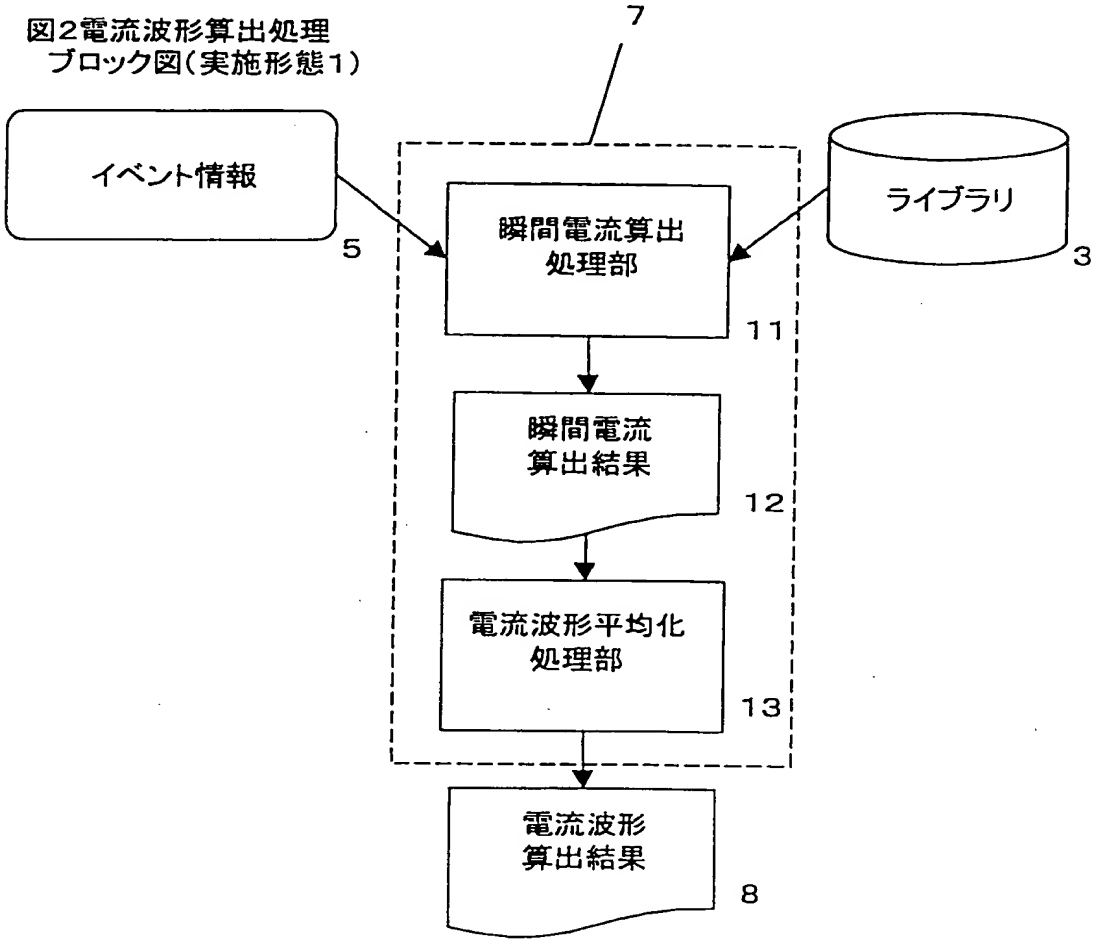


Fig. 3

図3 瞬間電流算出結果

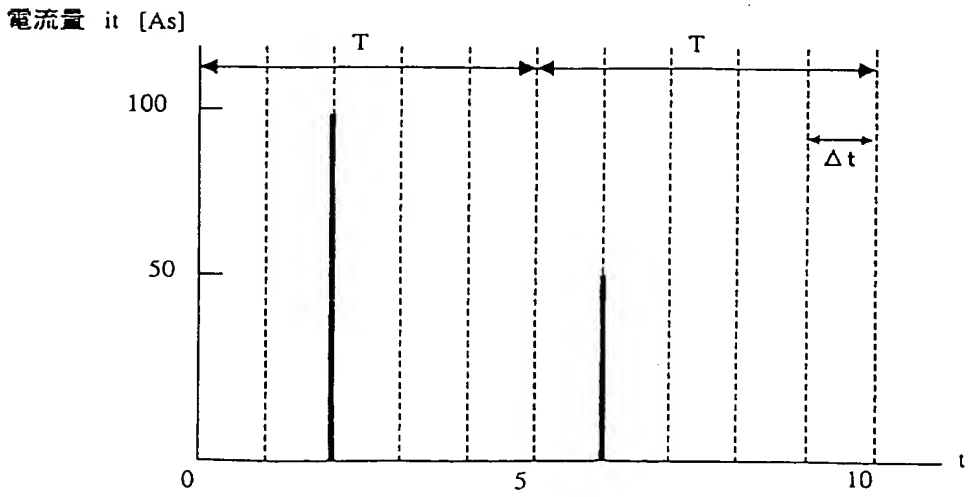


Fig. 4

図4 電流波形平均化処理フロー図

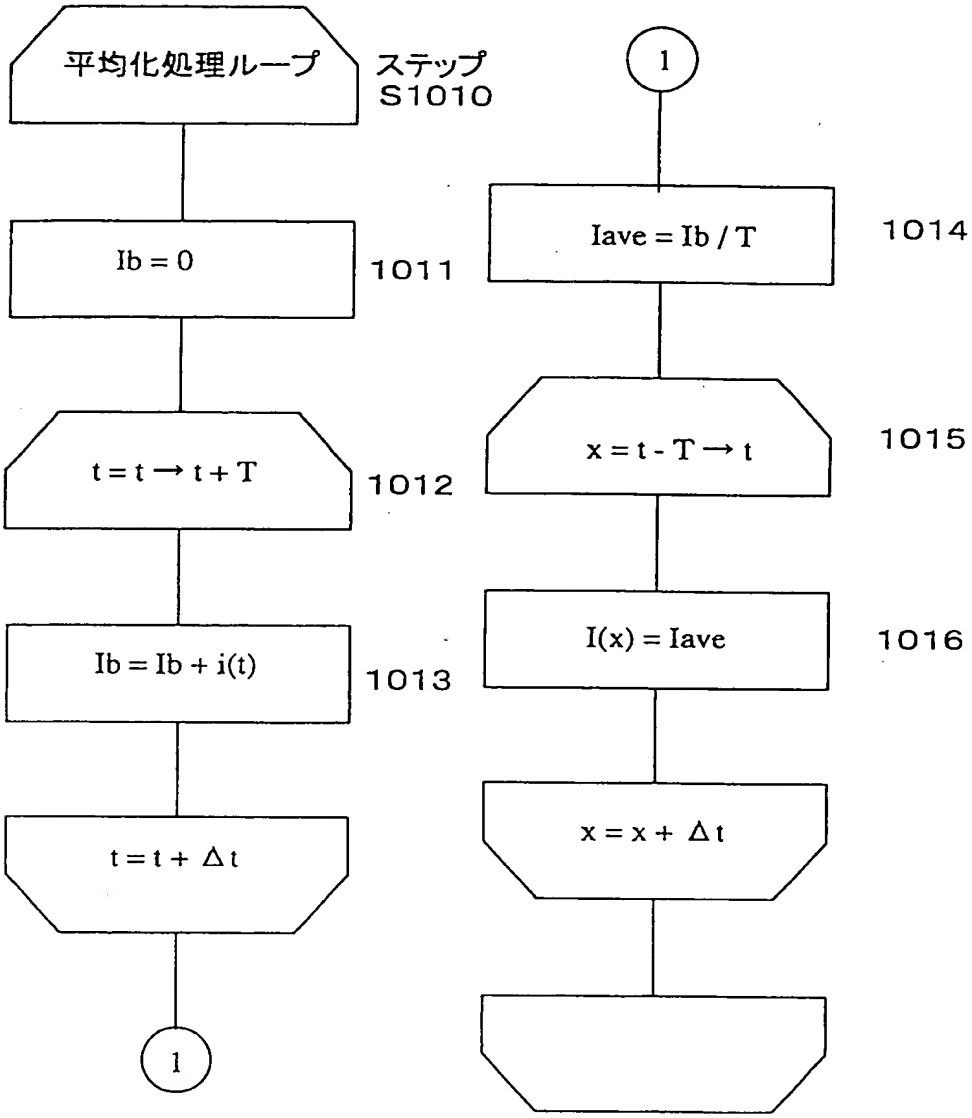
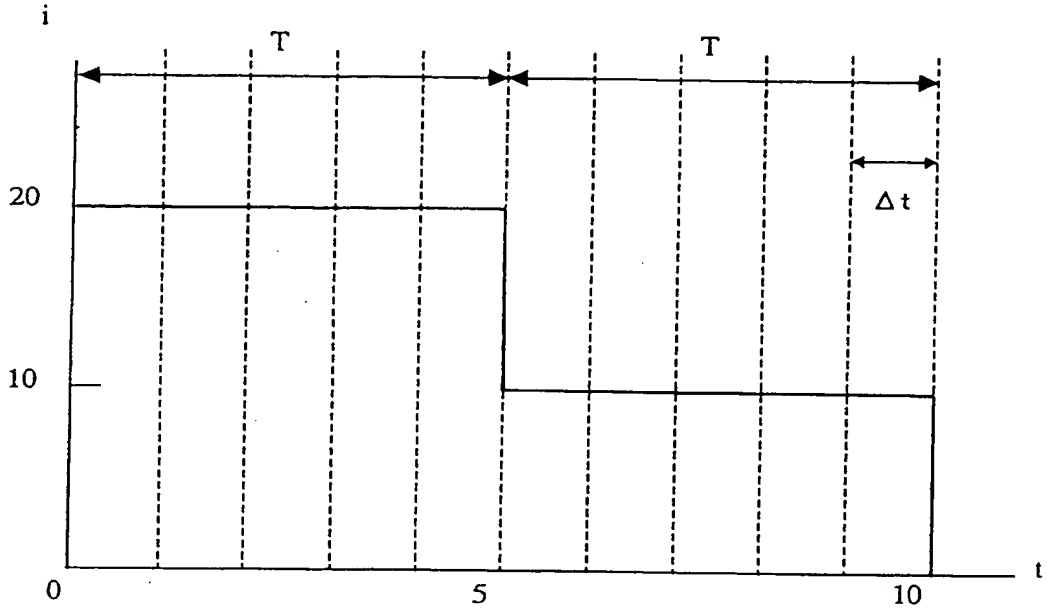


Fig. 5

図5 電流波形算出結果(実施形態1)



T＝5の時

Fig. 6

図6 FFT解析結果

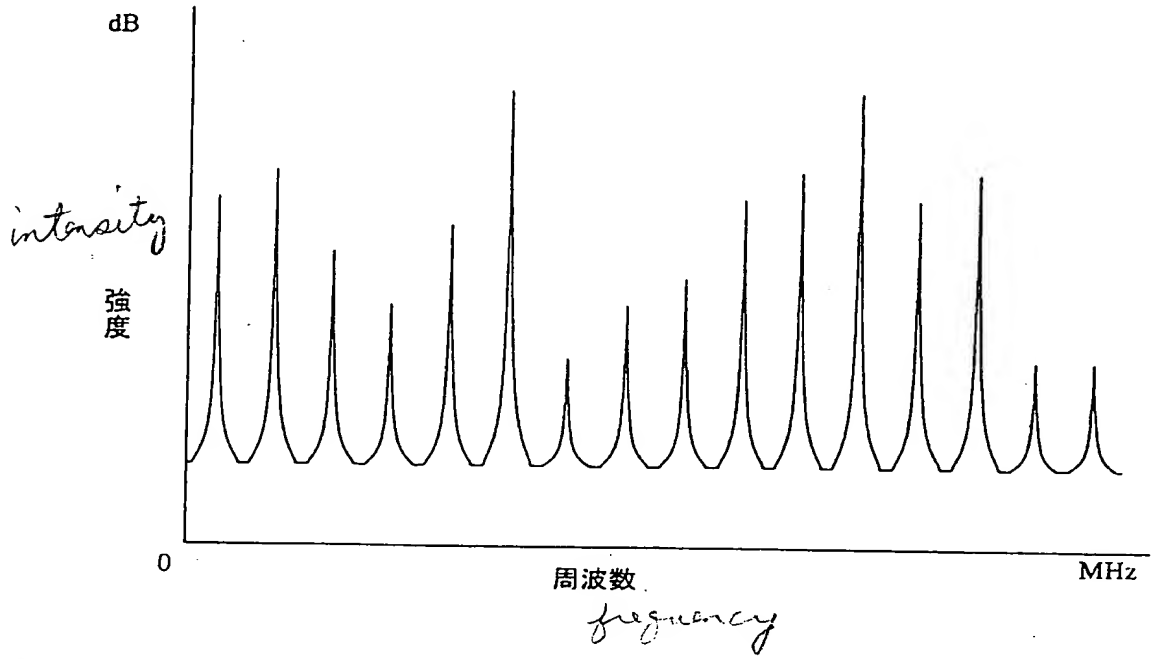


Fig. 7

図7 矩形波モデル(実施形態2)

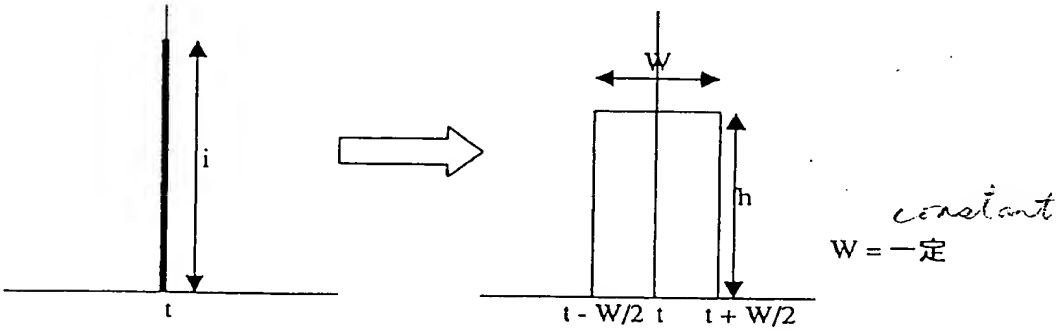


Fig. 8

図8電流波形算出処理
ブロック図(実施形態2)

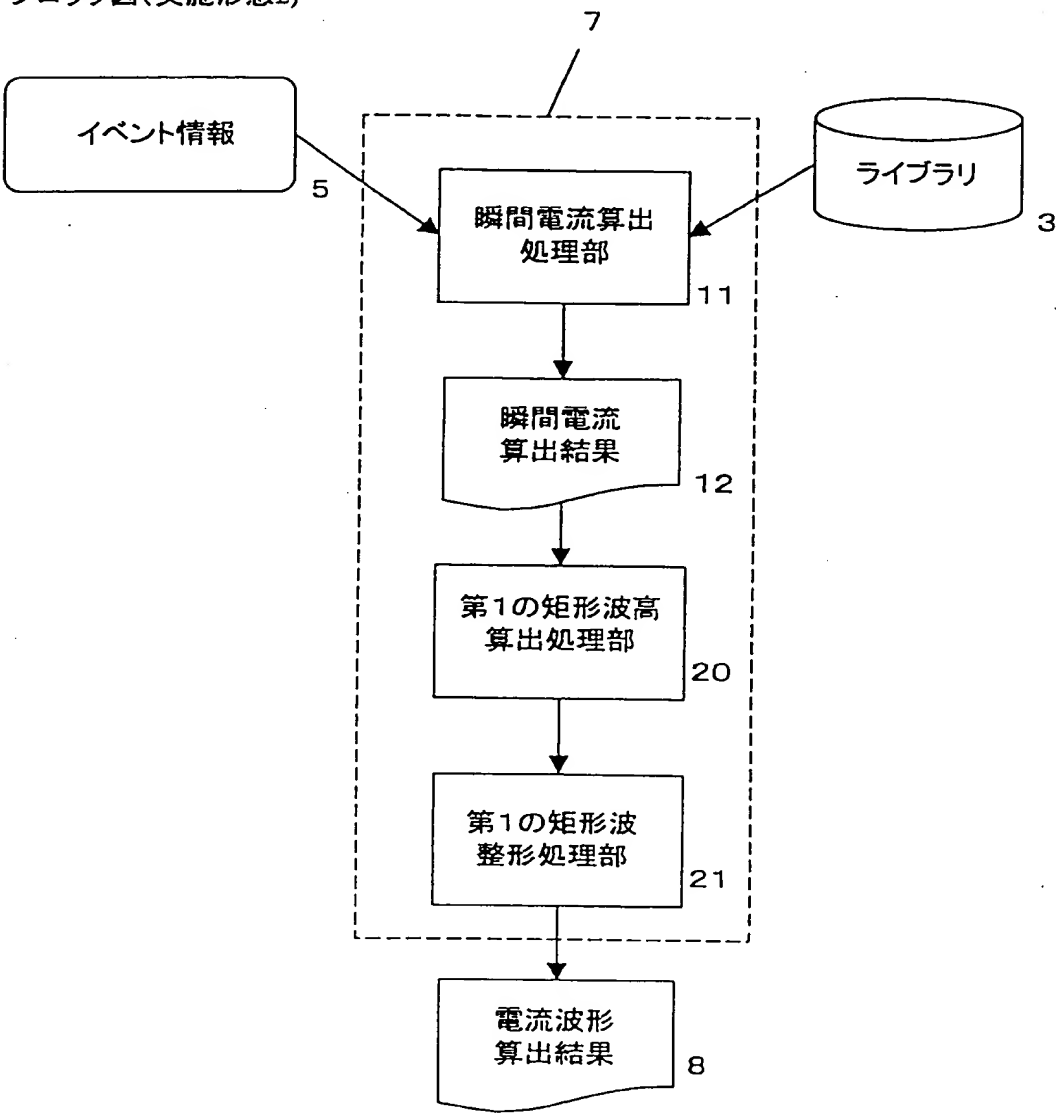


Fig. 9

図9 第1の矩形波整形処理フロー図

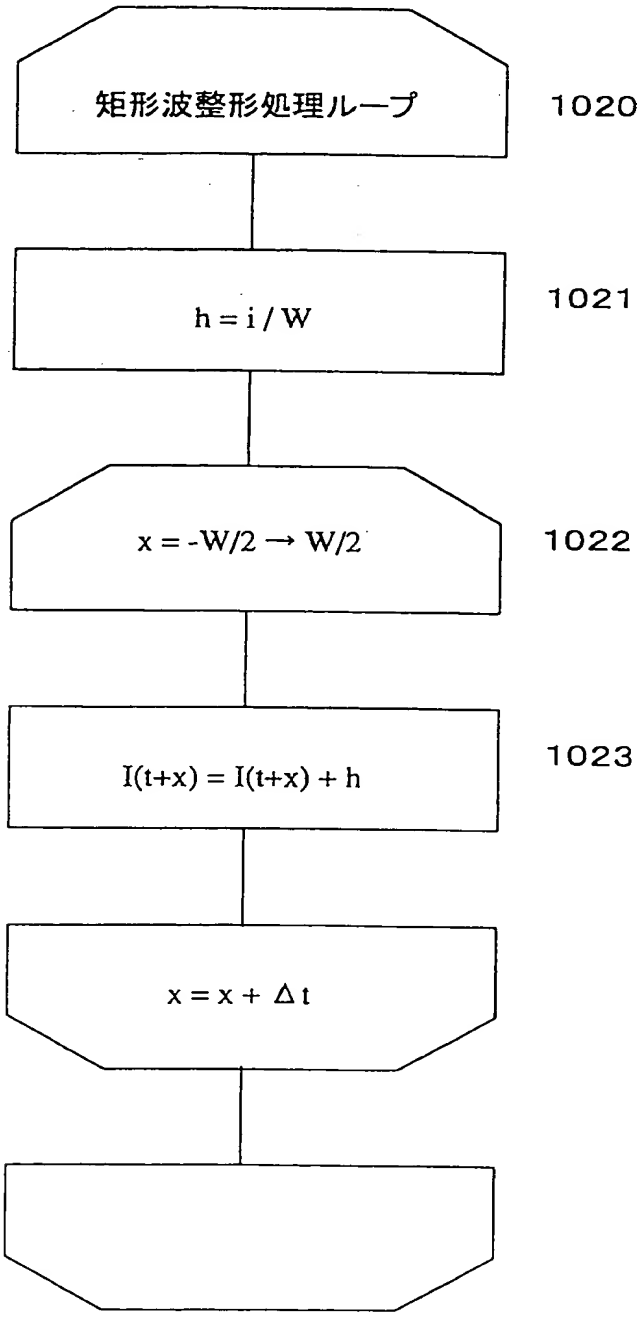
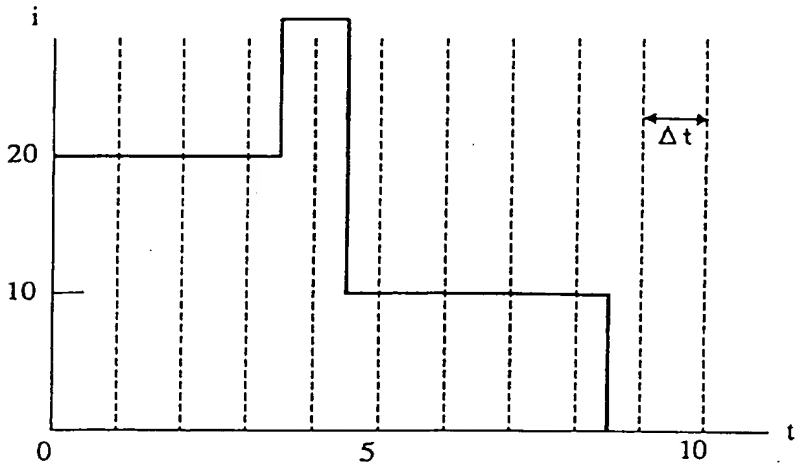


Fig. 10

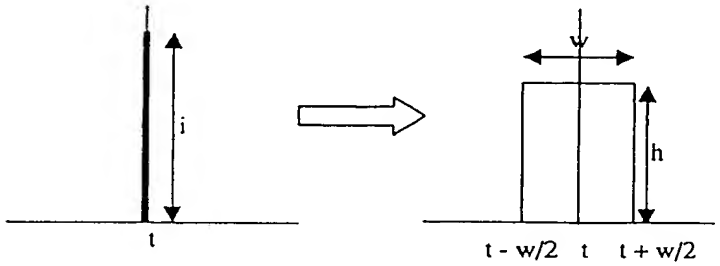
図10 電流波形算出結果(実施形態2)



W＝5の時

Fig. 11

図11 矩形波モデル(実施形態3)



$i = W \times h = \frac{h^2}{K}$

$h = \sqrt{(i \times K)}$

h/w＝K＝一定

Fig. 12

図12 電流波形算出処理
ブロック図(実施形態3)

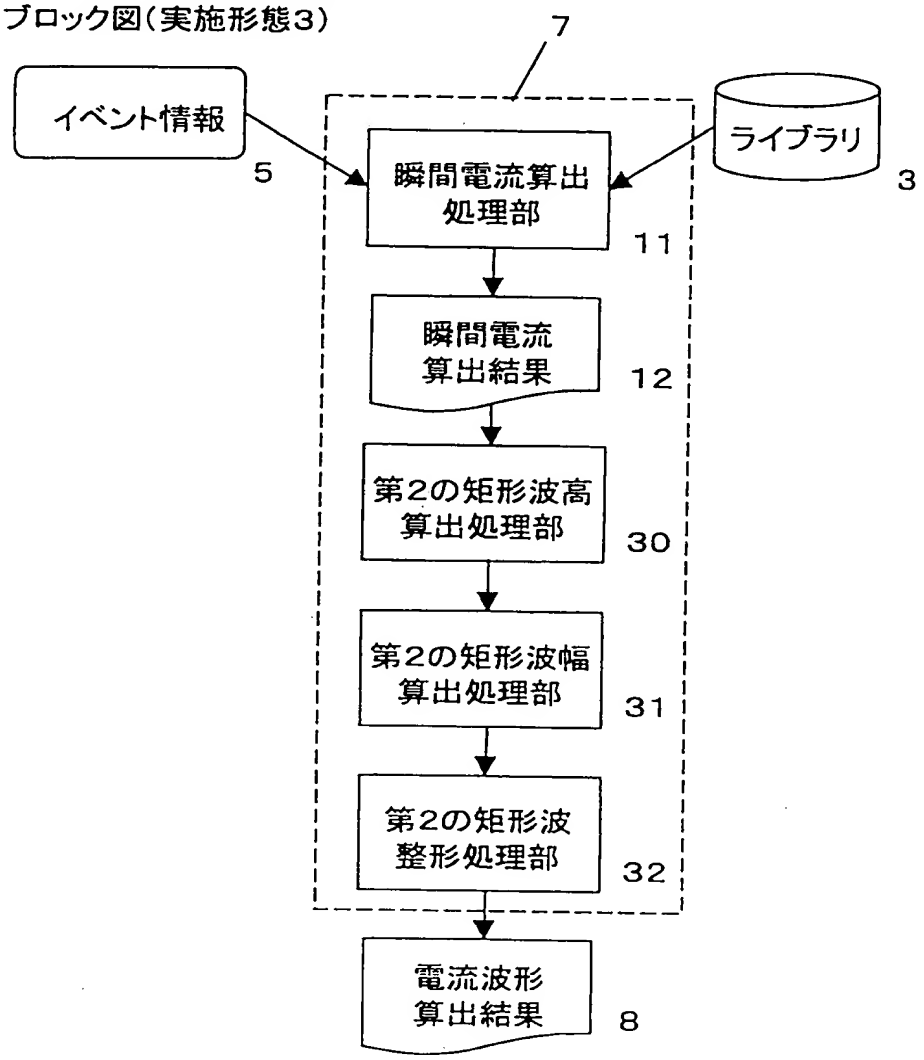


Fig. 13

図13 第2の矩形波整形処理フロー図

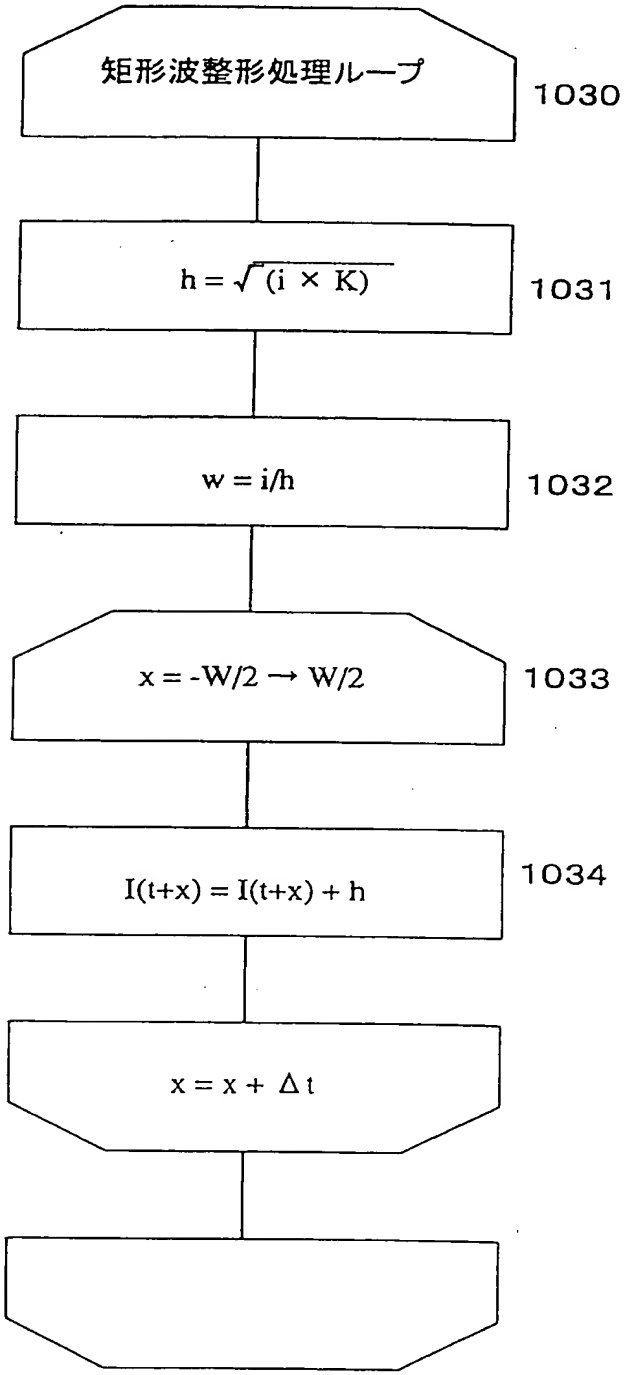
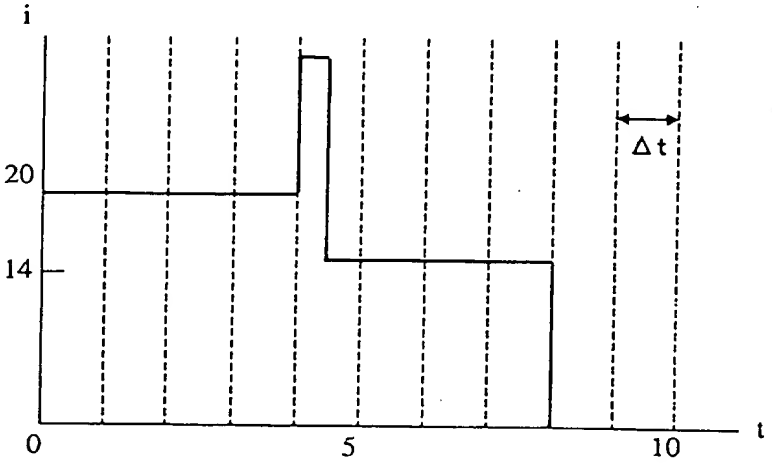


Fig. 14

図14 電流波形算出結果(実施形態3)



K＝4の時

Fig. 15

図15 矩形波モデル(実施形態4,5,6)

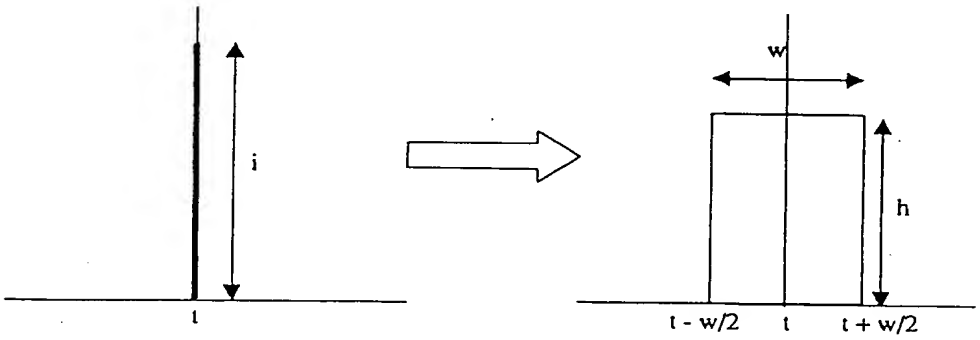
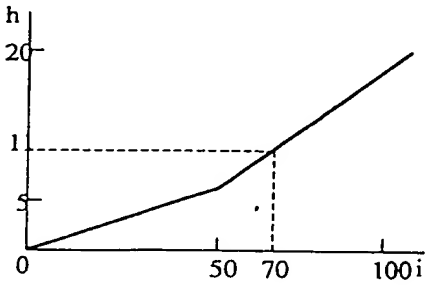


Fig. 16

図16 i-hテーブル

i	h
0	0
50	5
100	20



i = 70 の場合
(i1,h1)=(50,5)
(i2,h2)=(100,20)

$$h(i)=\frac{h2-h1}{i2-i1}(i-i1)+h1$$

h(70)=11

Fig. 17

図17 電流波形算出処理
ブロック図(実施形態4)

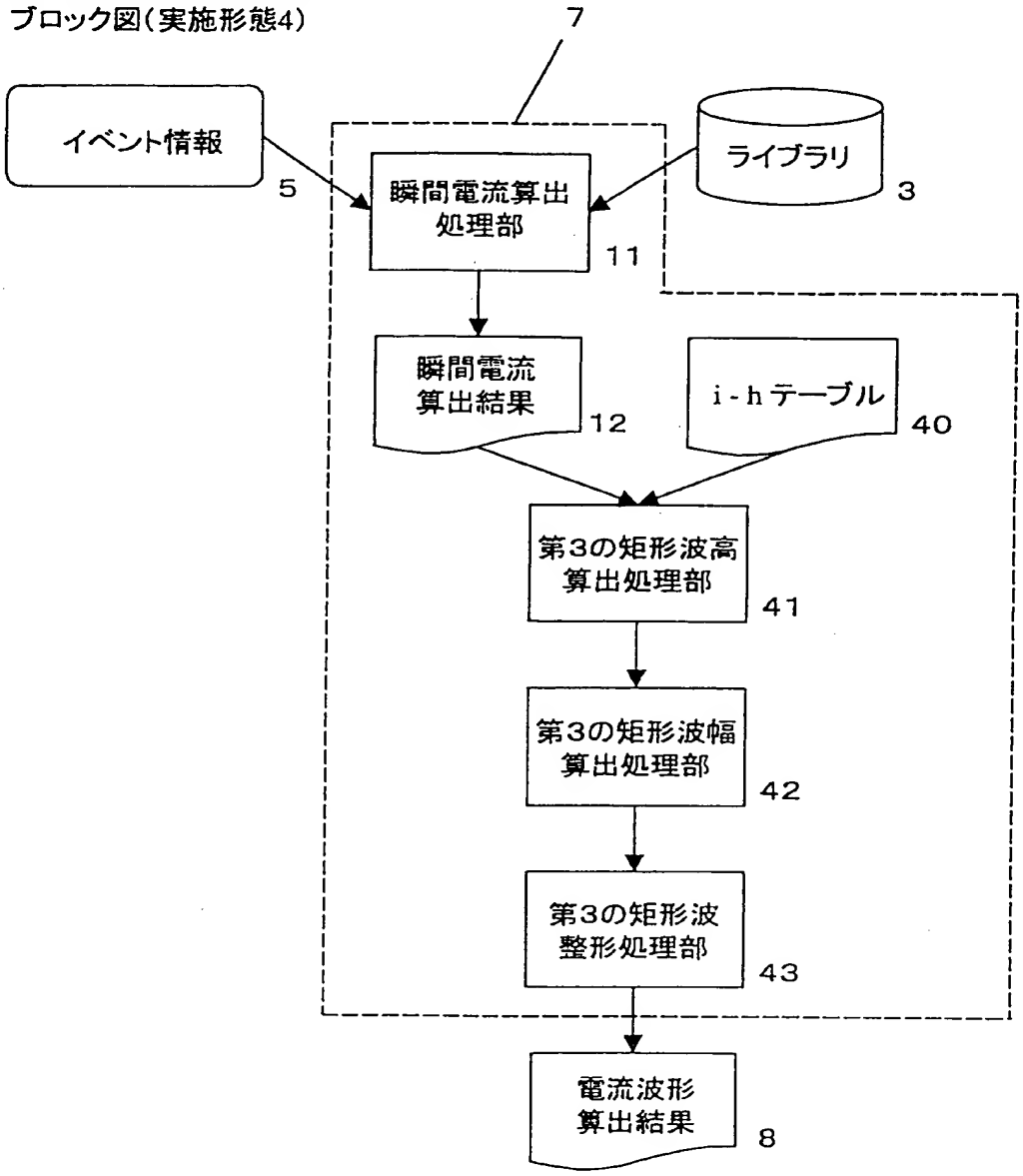


Fig. 18

図18 第3の矩形波整形処理フロー図

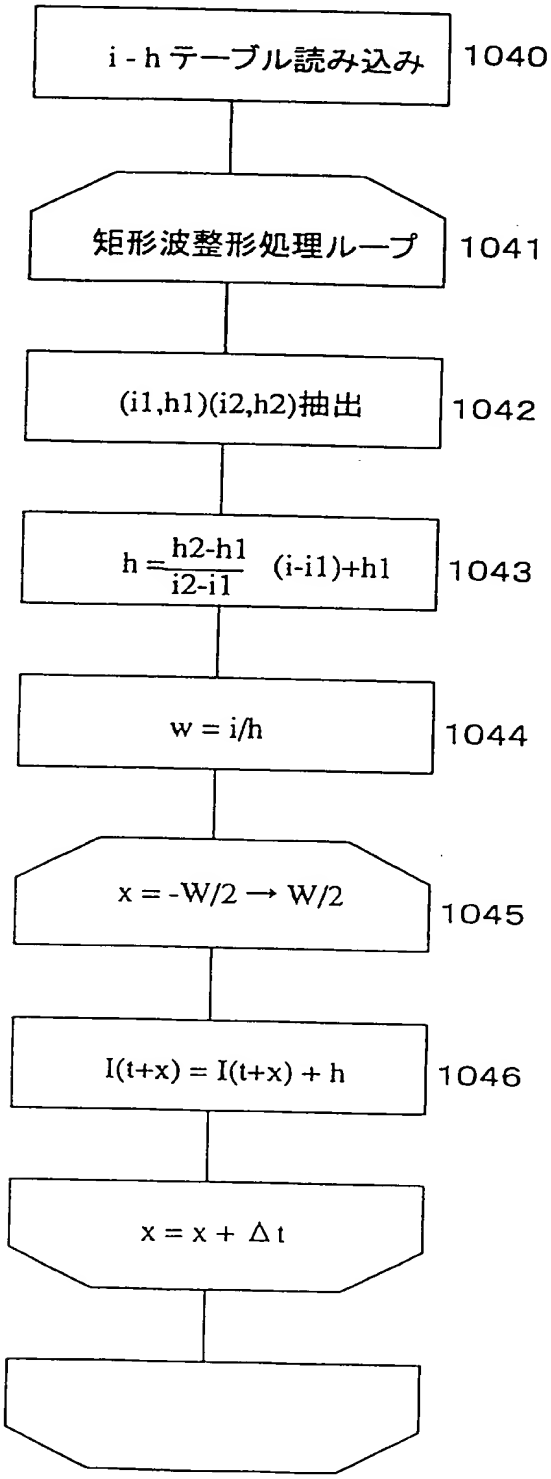


Fig. 19

図19 電流波形算出結果(実施形態4)

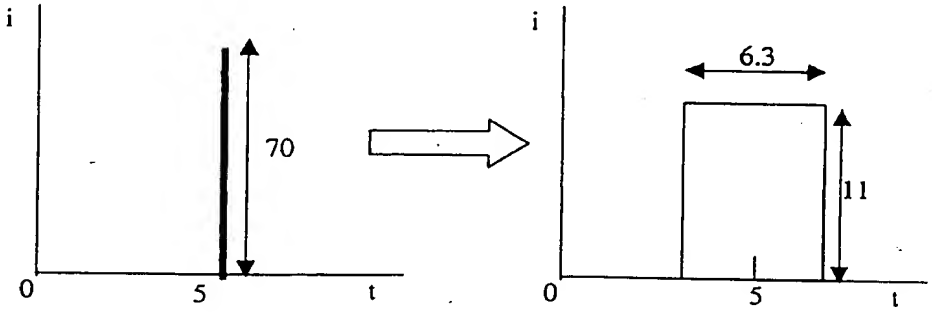
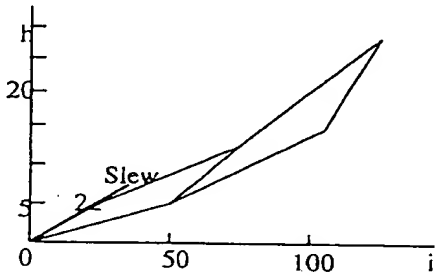


Fig. 20

図 20 i-s-h テーブル

s \ i	0	50	100
0	0	5	14
2	0	6	20



i＝70,s＝1　の場合

s1＝0,s2＝2,i1＝50,i2＝100
h(s1,i1)＝5,h(s1,i2)＝14
h(s2,i1)＝6,h(s2,i2)＝20

$$h(s,i)=\left(\frac{h(s1,i1)(s2-s)}{(s2-s1)}+\frac{h(s2,i1)(s-s1)}{(s2-s1)}\right)\left(\frac{i2-i}{i2-i1}\right)+\left(\frac{h(s1,i2)(s2-s)}{(s2-s1)}+\frac{h(s2,i2)(s-s1)}{(s2-s1)}\right)\left(\frac{i-i1}{i2-i1}\right)$$

h(1,70)＝10.1

Fig. 21

図21 電流波形算出処理
ブロック図(実施形態5)

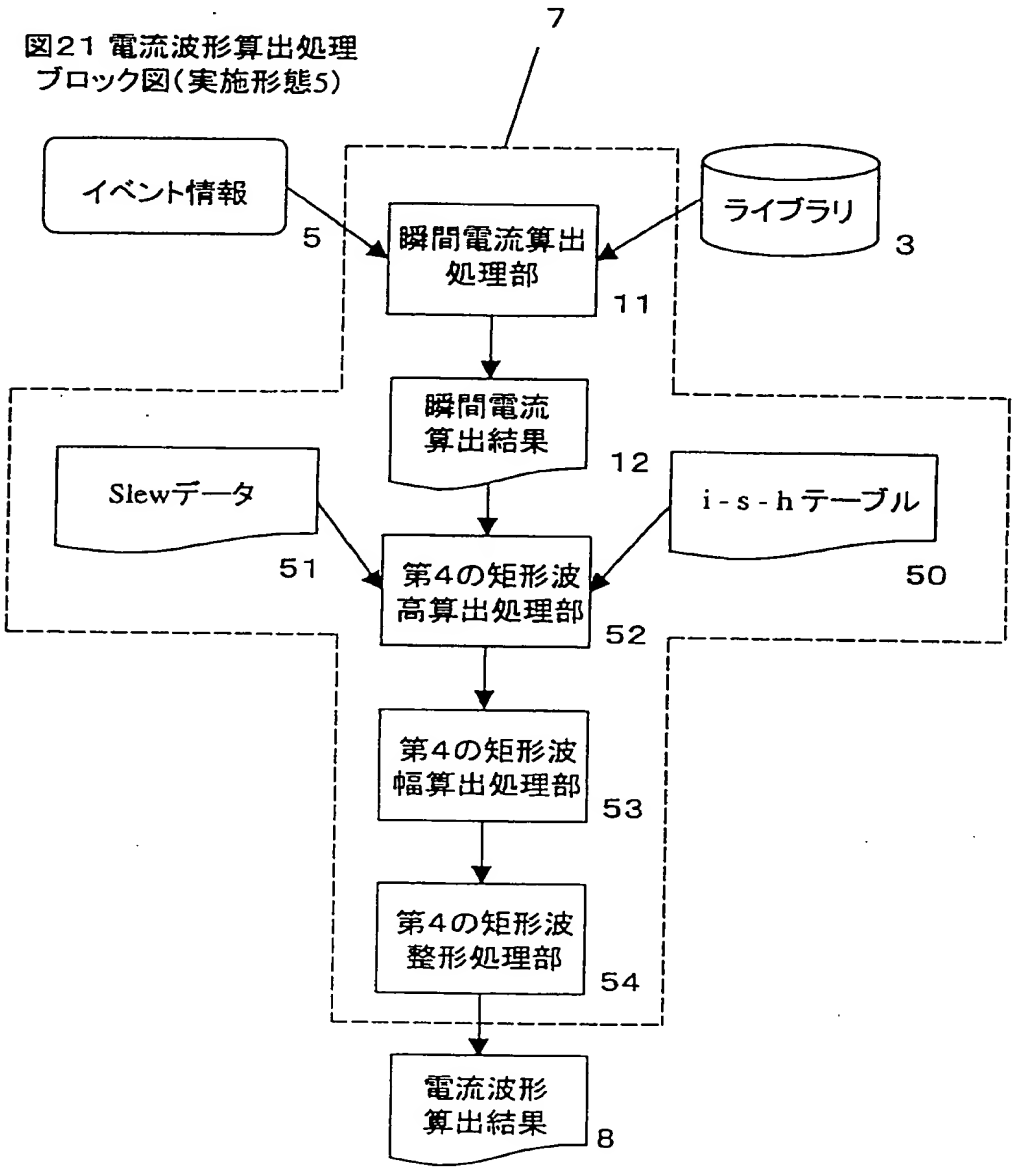


Fig. 22

図22 第4の矩形波整形処理フロー図

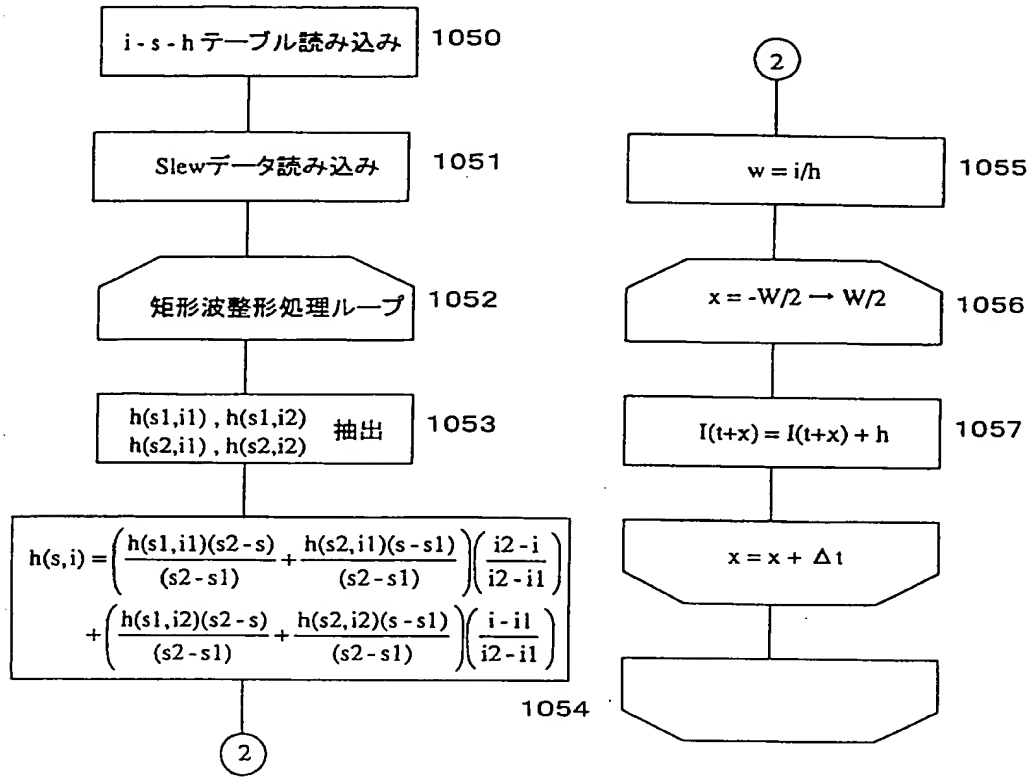


Fig. 23

図23 電流波形算出結果(実施形態5)

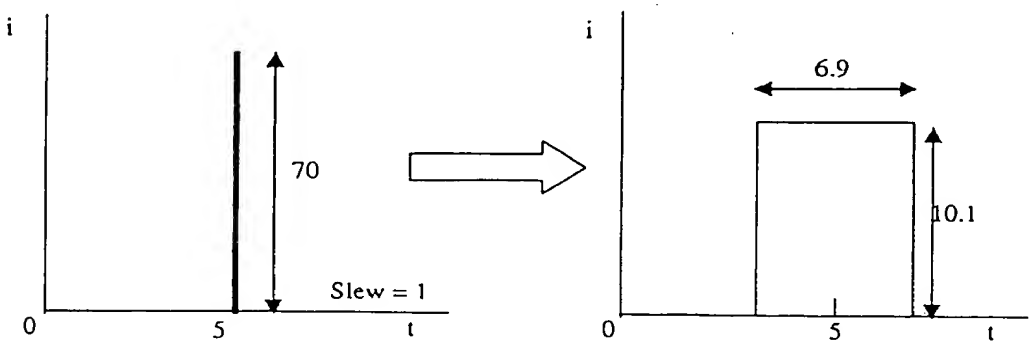
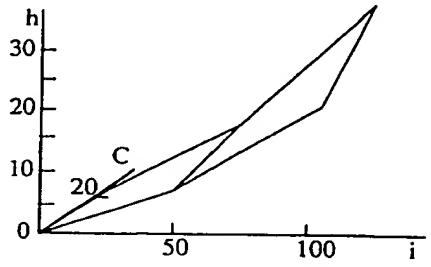


Fig. 24

図24 i - c - h テーブル

C \ i	0	50	100
0	0	5	20
20	0	8	25



i＝70,c＝10の場合

c1＝0,c2＝20,i1＝50,i2＝100

h(c1,i1)＝5,h(c1,i2)＝20

h(c2,i1)＝8,h(c2,i2)＝25

$$h(s,i)=\left(\frac{h(c1,i1)(c2-c)}{(c2-c1)}+\frac{h(c2,i1)(c-c1)}{(c2-c1)}\right)\left(\frac{i2-i}{i2-i1}\right)+\left(\frac{h(c1,i2)(c2-c)}{(c2-c1)}+\frac{h(c2,i2)(c-c1)}{(c2-c1)}\right)\left(\frac{i-i1}{i2-i1}\right)$$

h(10,70)＝12.9

Fig. 25

図25 電流波形算出処理
ブロック図(実施形態6)

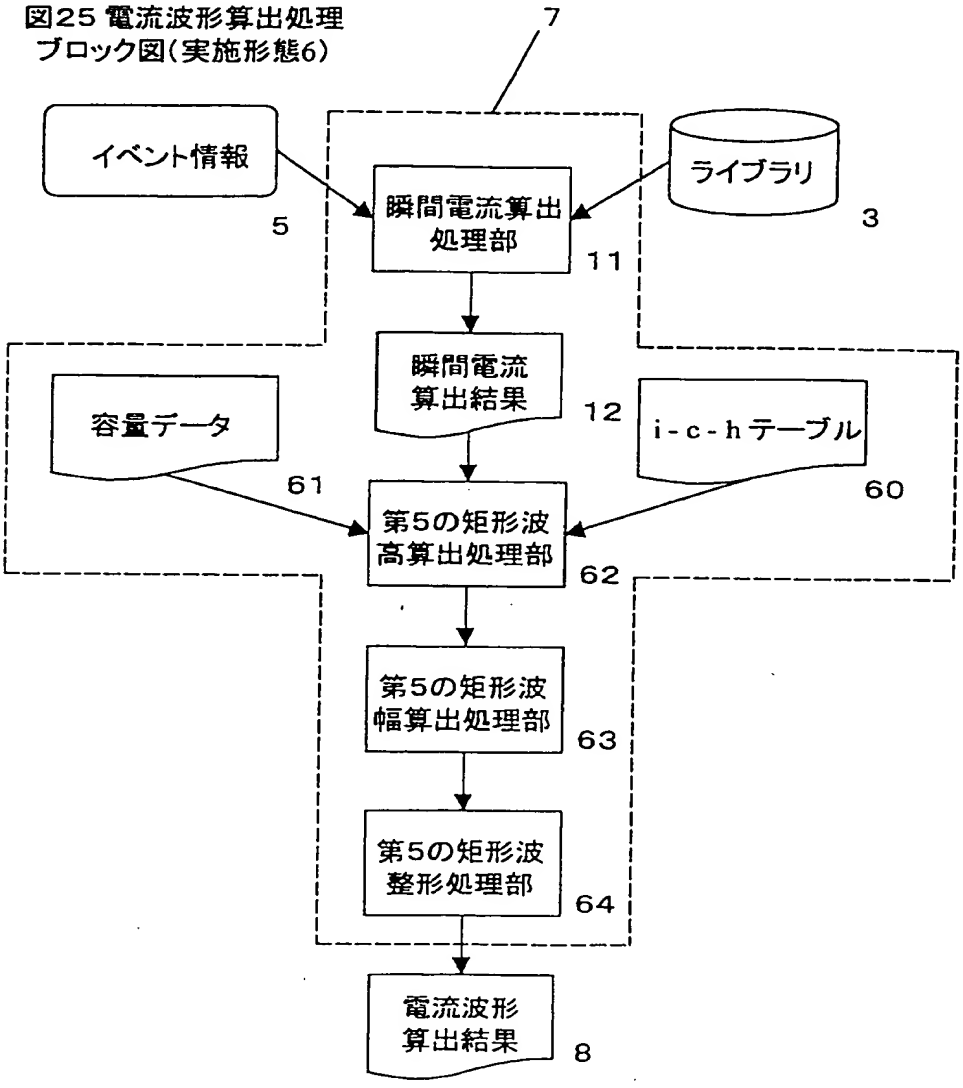


Fig. 26

図26 第5の矩形波整形処理フロー図

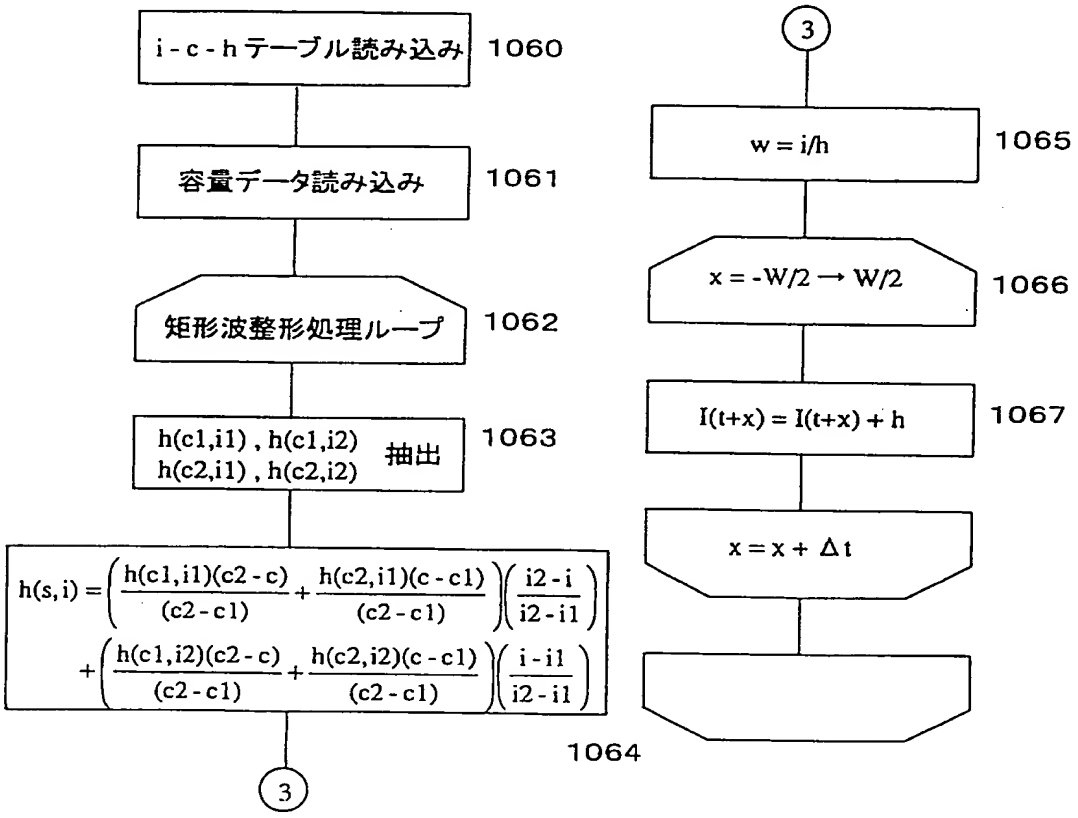


Fig. 27

図27 電流波形算出結果(実施形態6)

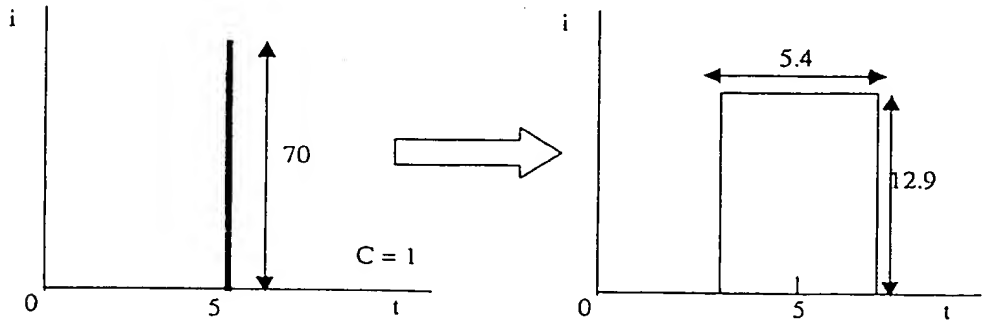


Fig. 28

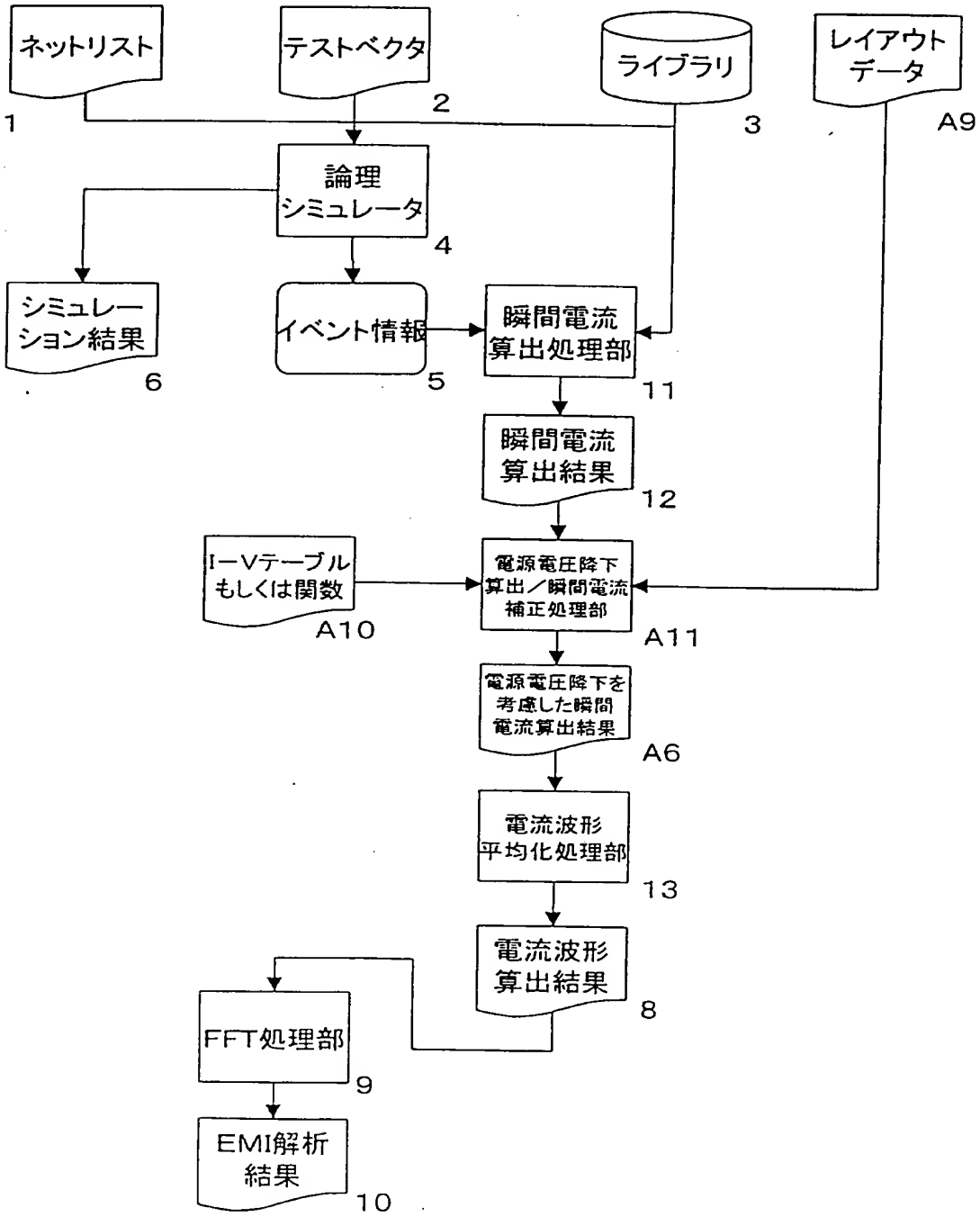


Fig. 29

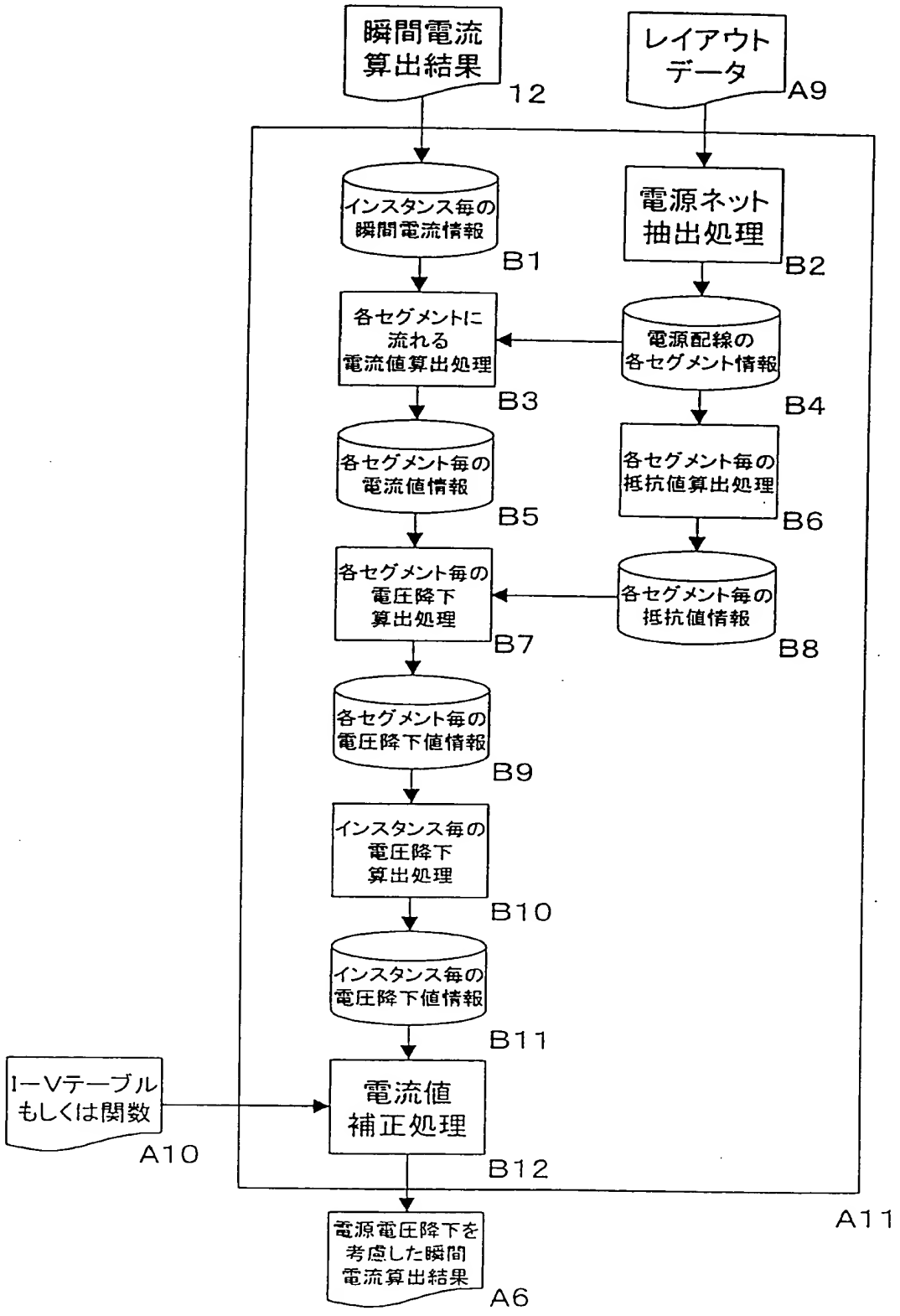

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Fig. 30

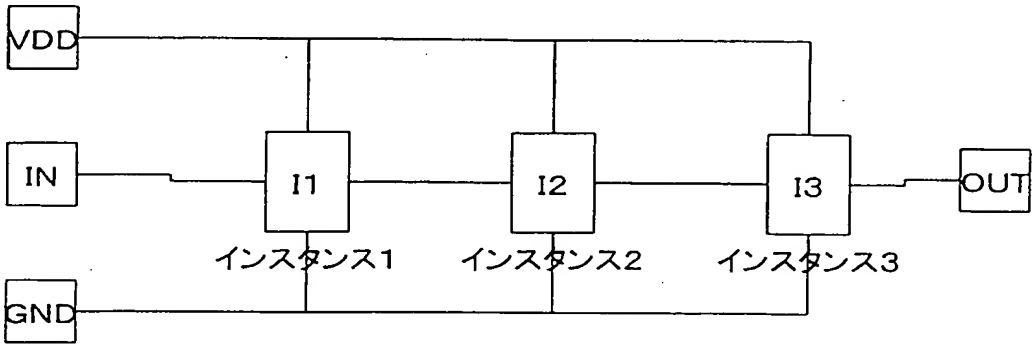


Fig. 31

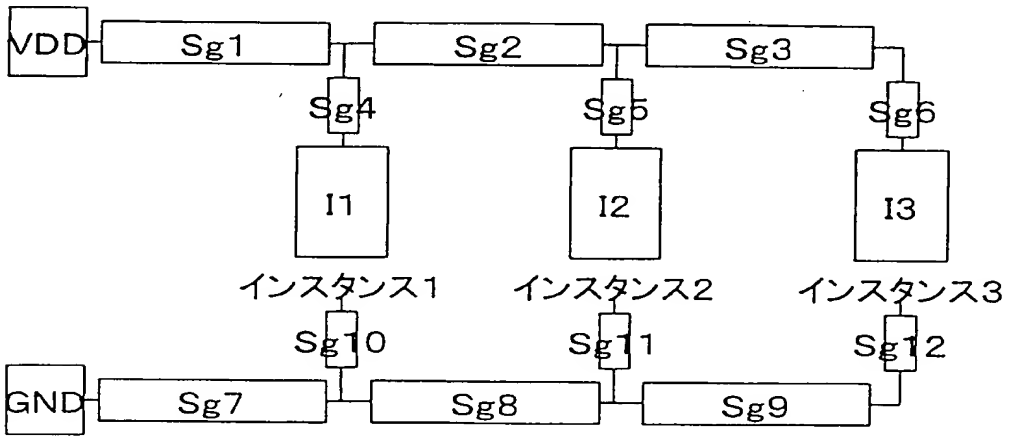


Fig. 32

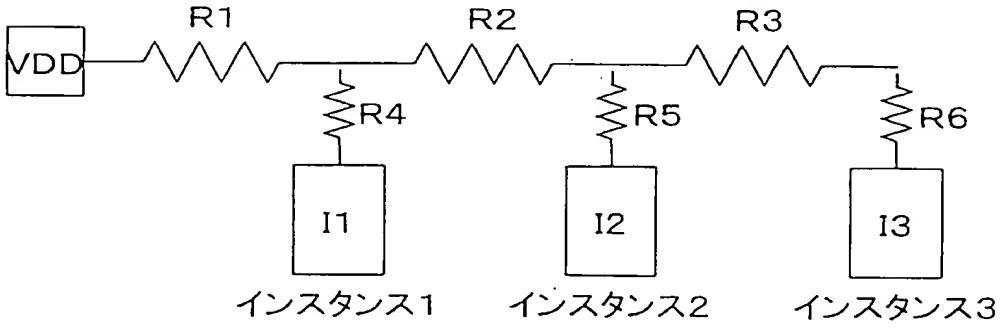
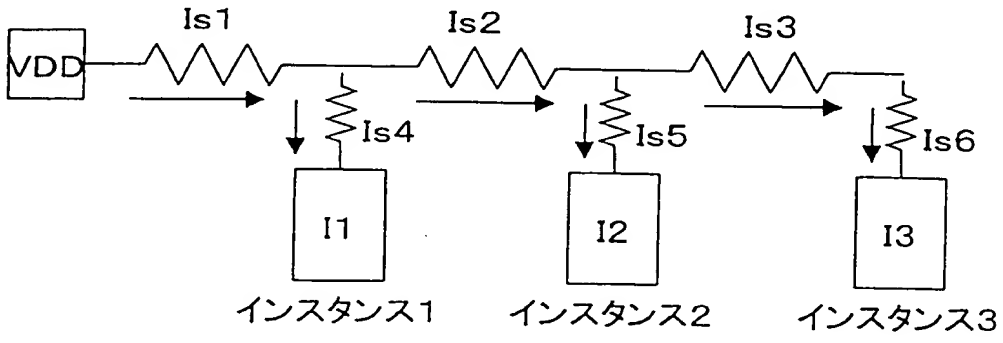
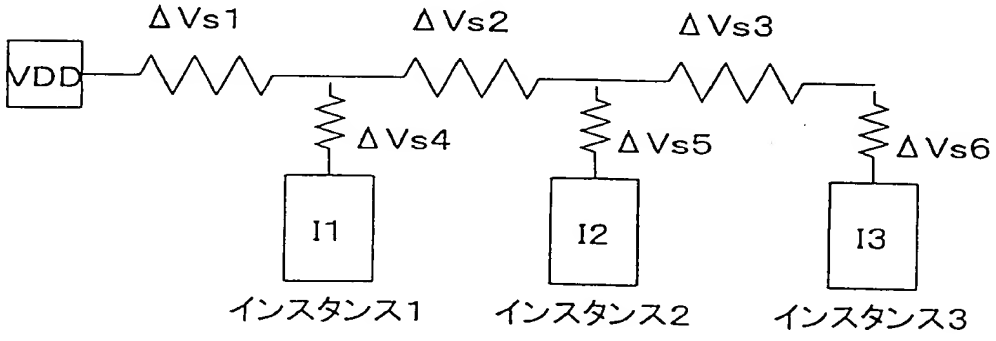


Fig. 33



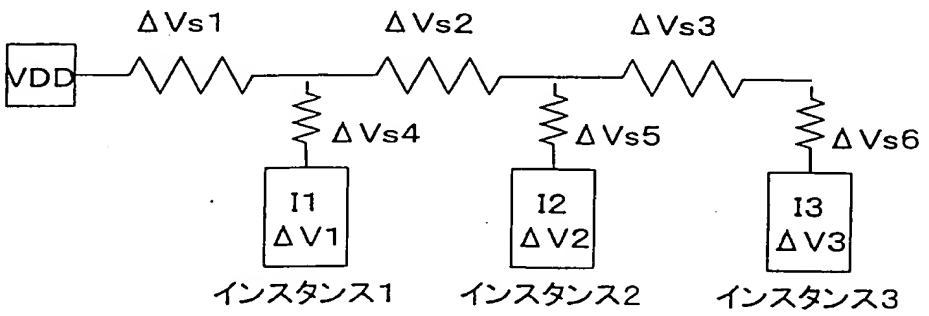
Is1＝I1＋I2＋I3
Is2＝I2＋I3
Is3＝I3
Is4＝I1
Is5＝I2
Is6＝I3

Fig. 34



ΔVs1＝R1＊Is1
ΔVs2＝R2＊Is2
ΔVs3＝R3＊Is3
ΔVs4＝R4＊Is4
ΔVs5＝R5＊Is5
ΔVs6＝R6＊Is6

Fig. 35



インスタンス1の電圧降下：ΔV1＝ΔVs1＋ΔVs4
インスタンス2の電圧降下：ΔV2＝ΔVs1＋ΔVs2＋ΔVs5
インスタンス3の電圧降下：ΔV3＝ΔVs1＋ΔVs2＋ΔVs3＋ΔVs6

Fig. 36

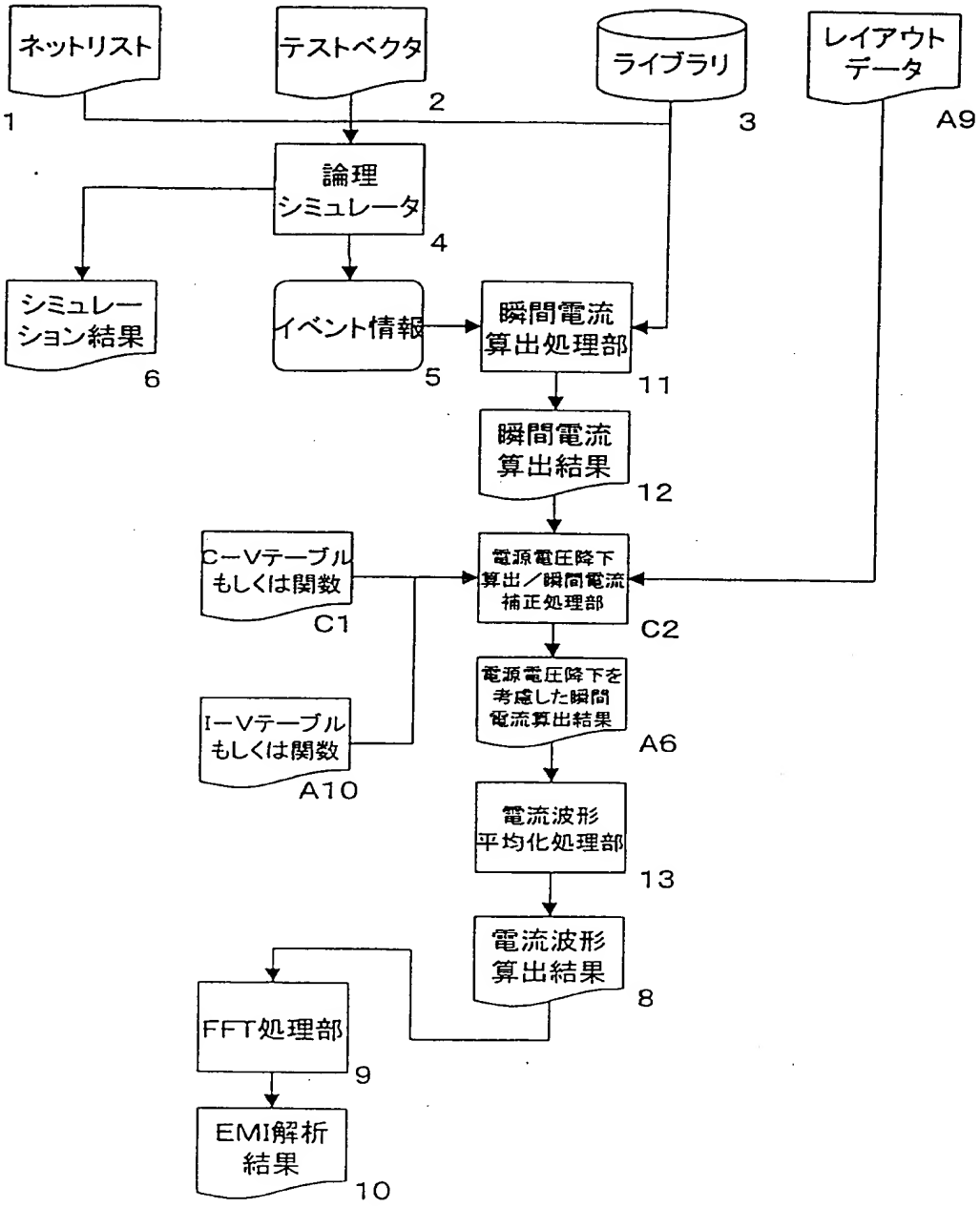

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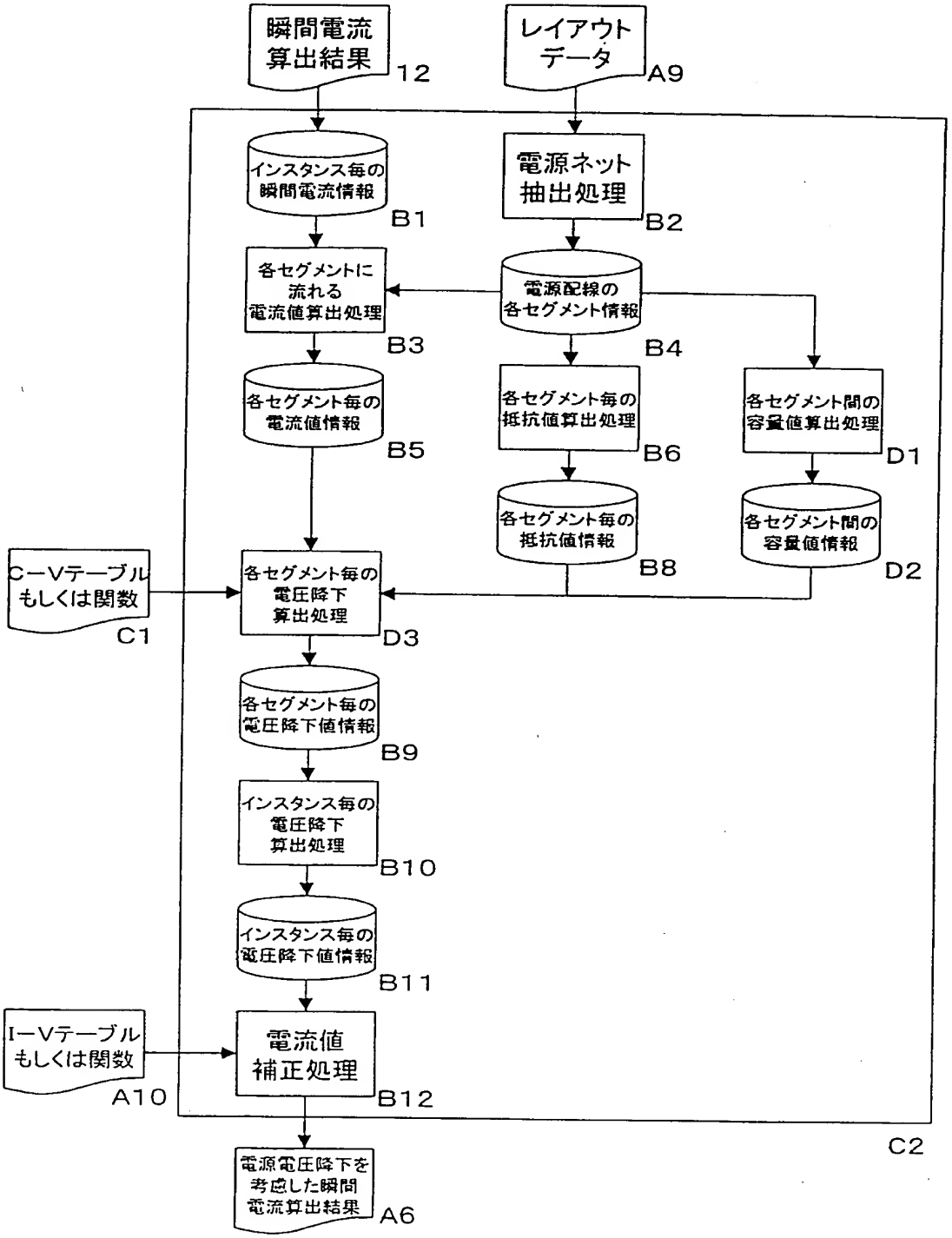
Fig. 37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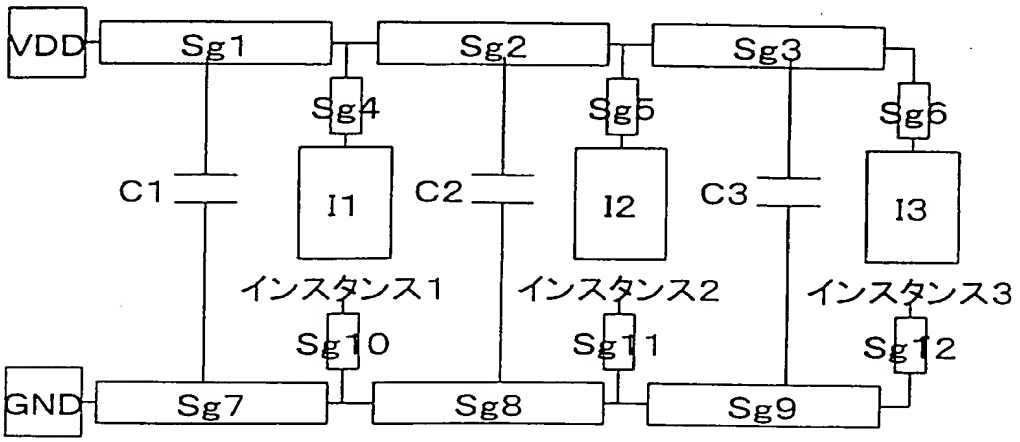
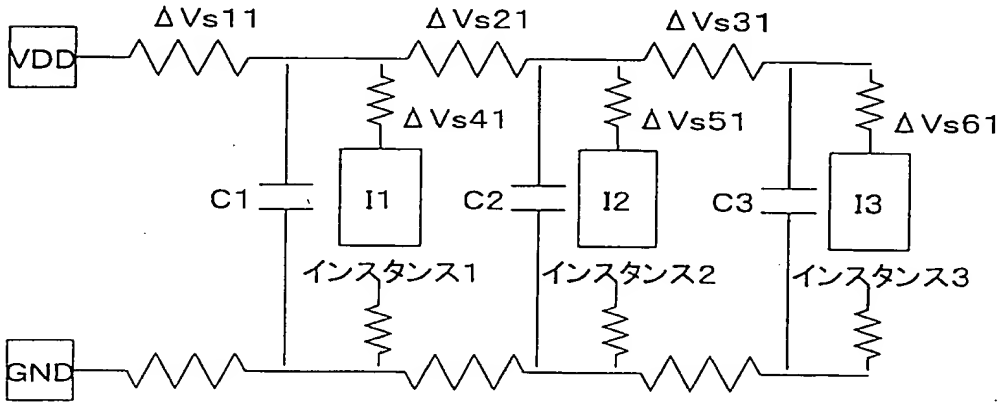


Fig. 39



ΔVs11＝f(C1、ΔVs1)
ΔVs21＝f(C2、ΔVs2)
ΔVs31＝f(C3、ΔVs3)
ΔVs41＝ΔVs4
ΔVs51＝ΔVs5
ΔVs61＝ΔVs6

インスタンス1の電圧降下：ΔV1＝ΔVs11＋ΔVs41
インスタンス2の電圧降下：ΔV2＝ΔVs11＋ΔVs21＋ΔVs51
インスタンス3の電圧降下：ΔV3＝ΔVs11＋ΔVs21＋ΔVs31＋ΔVs61

Fig. 40

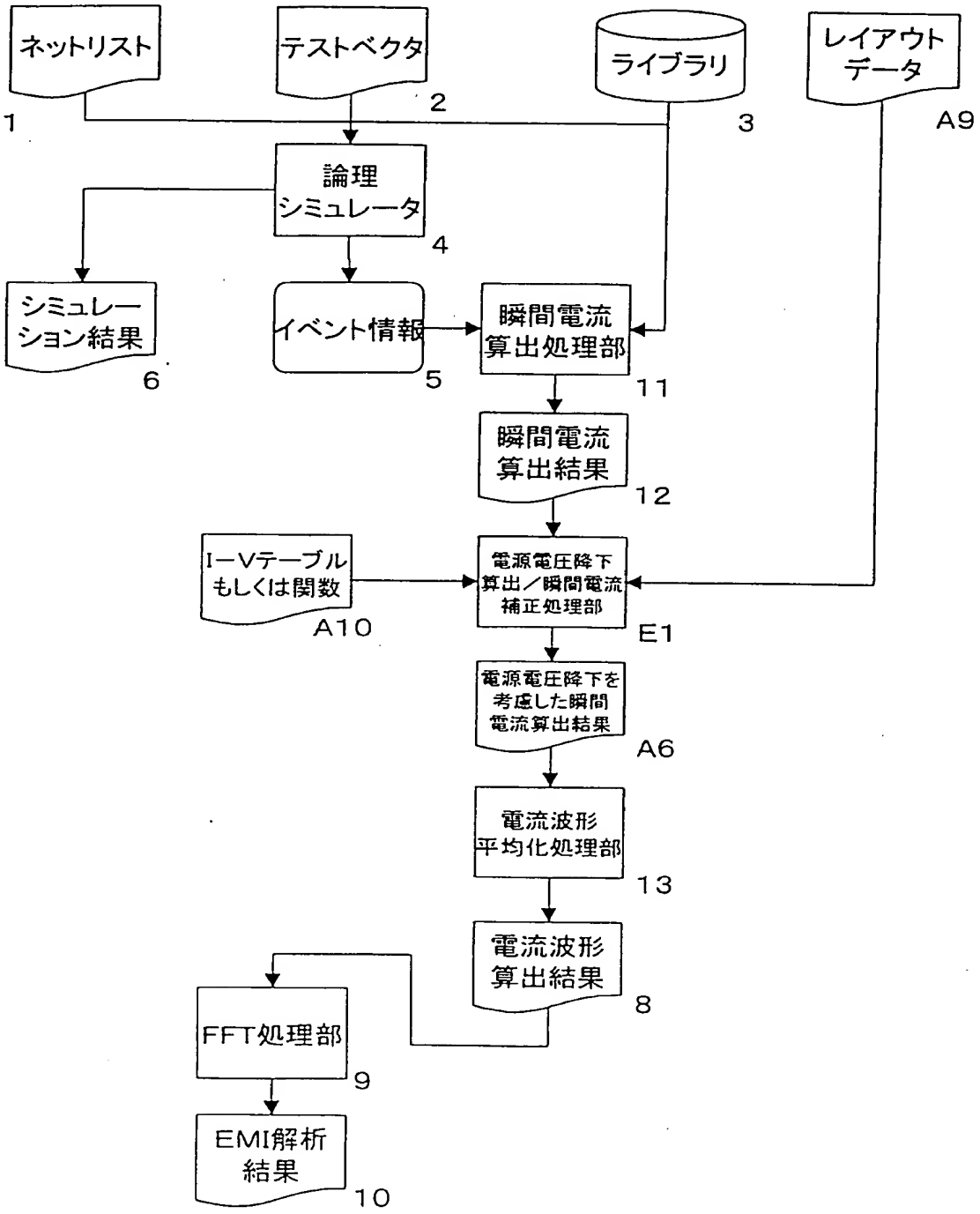

ネットリスト
1
テストベクタ
2
ライブラリ
3
レイアウトデータ
A9
論理シミュレータ
4
シミュレーション結果
6
イベント情報
5
瞬間電流算出処理部
11
瞬間電流算出結果
12
I−Vテーブルもしくは関数
A10
電源電圧降下算出／瞬間電流補正処理部
E1
電源電圧降下を考慮した瞬間電流算出結果
A6
電流波形平均化処理部
13
電流波形算出結果
8
FFT処理部
9
EMI解析結果
10

Fig. 41

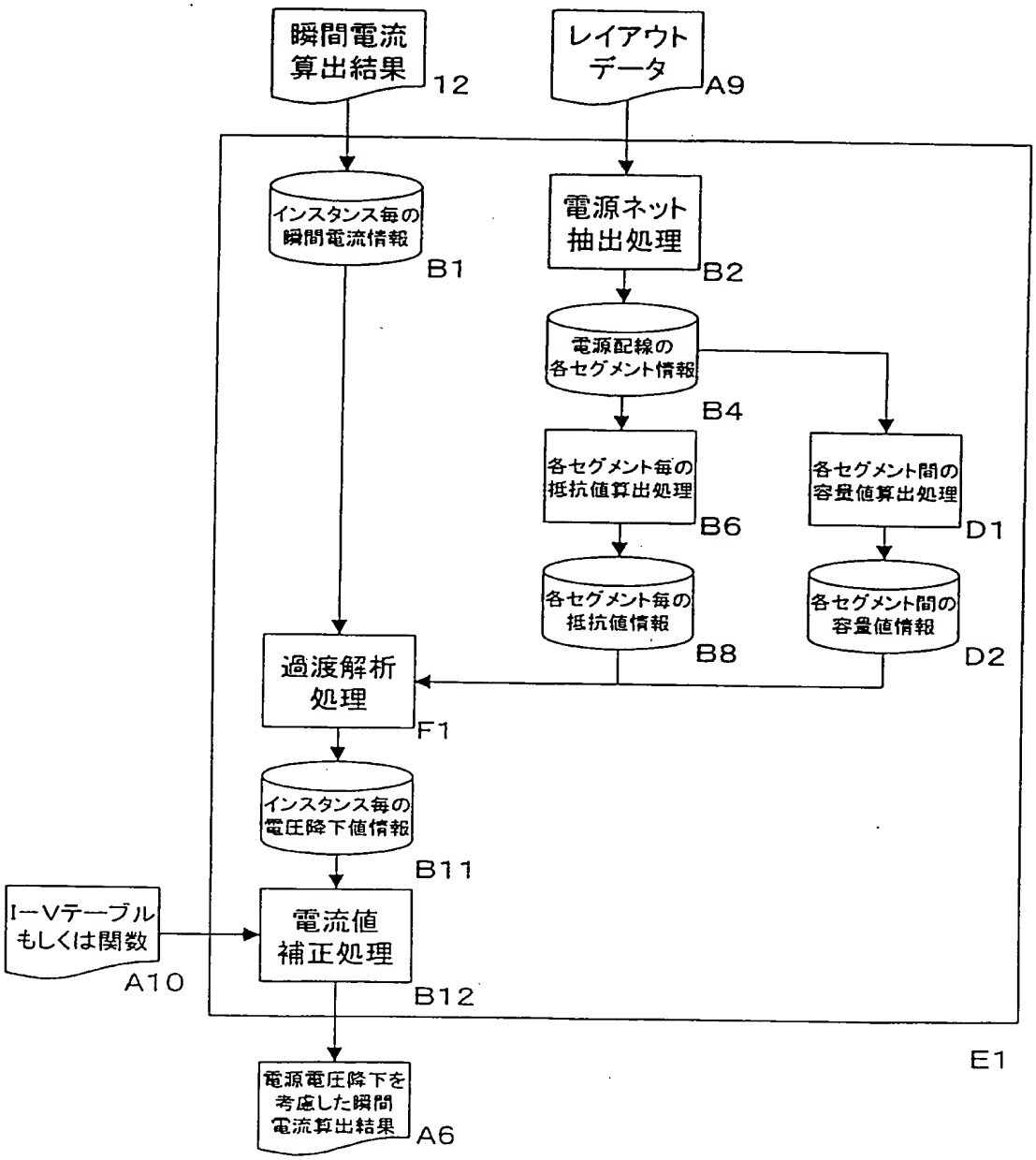

瞬間電流
算出結果
12
レイアウト
データ
A9
インスタンス毎の
瞬間電流情報
B1
電源ネット
抽出処理
B2
電源配線の
各セグメント情報
B4
各セグメント毎の
抵抗値算出処理
B6
各セグメント間の
容量値算出処理
D1
各セグメント毎の
抵抗値情報
B8
各セグメント間の
容量値情報
D2
過渡解析
処理
F1
インスタンス毎の
電圧降下値情報
B11
I−Vテーブル
もしくは関数
A10
電流値
補正処理
B12
E1
電源電圧降下を
考慮した瞬間
電流算出結果
A6

Fig. 42

図42 三角波モデル(実施形態10)

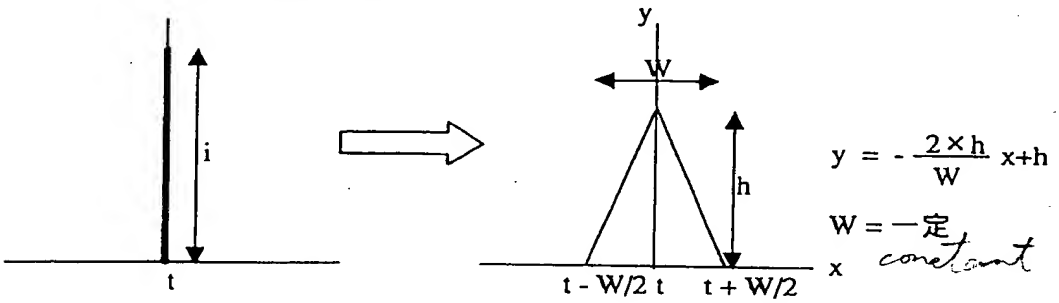


Fig. 43

図43 電流波形算出処理
ブロック図(実施形態10)

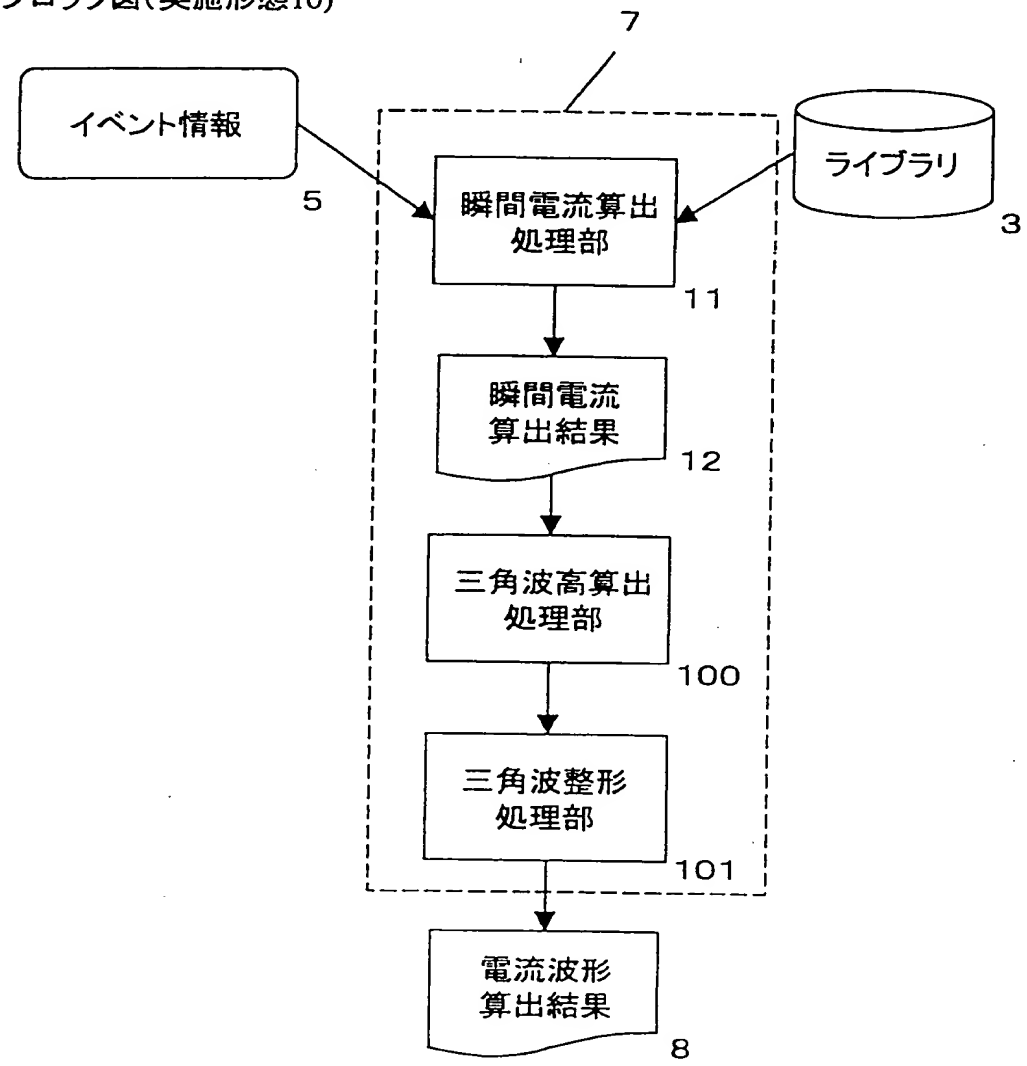


Fig. 44

図44 三角波整形処理フロー図

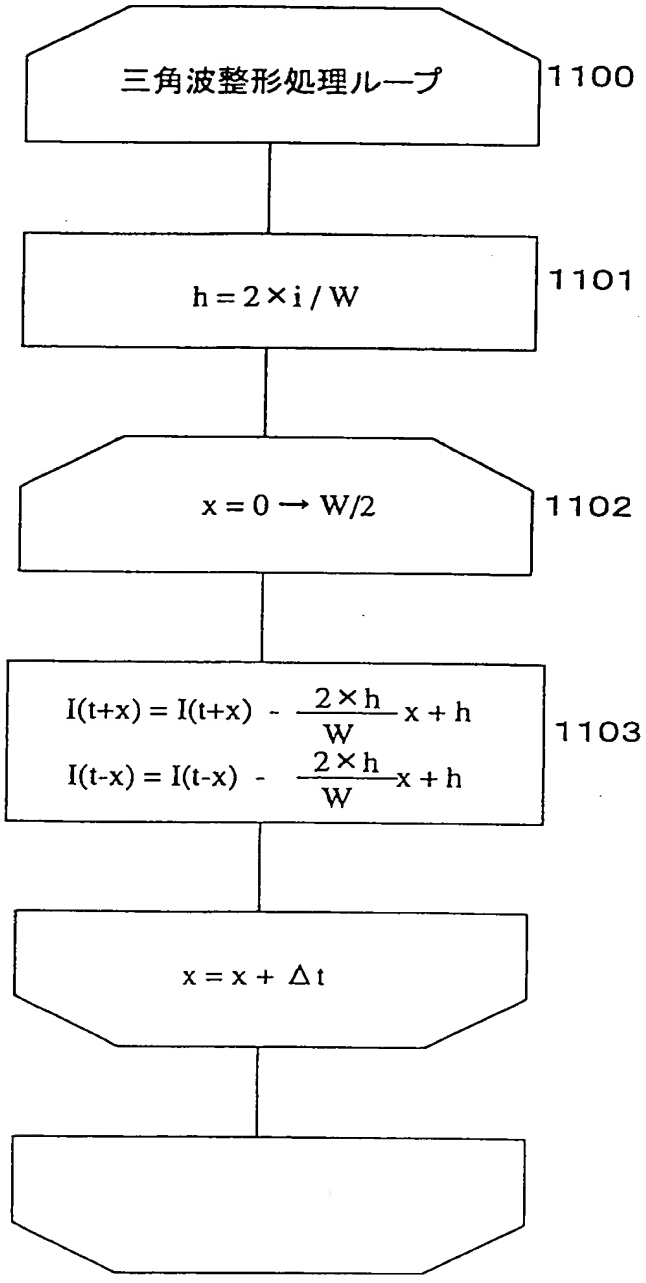
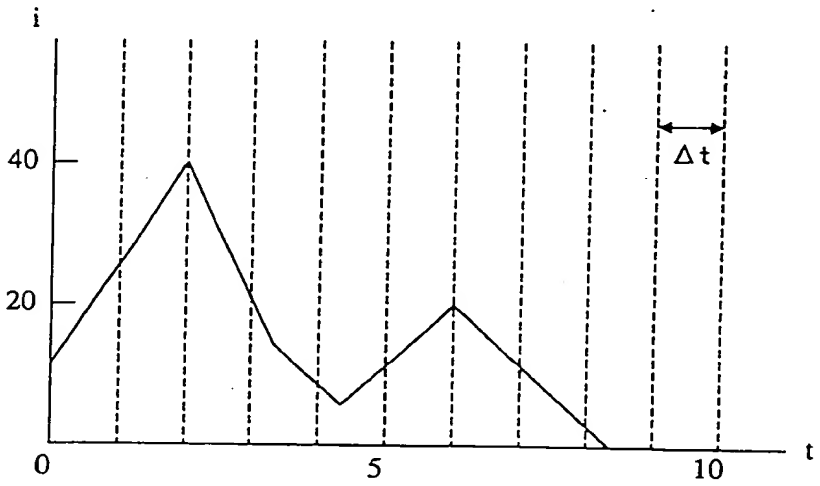


Fig. 45

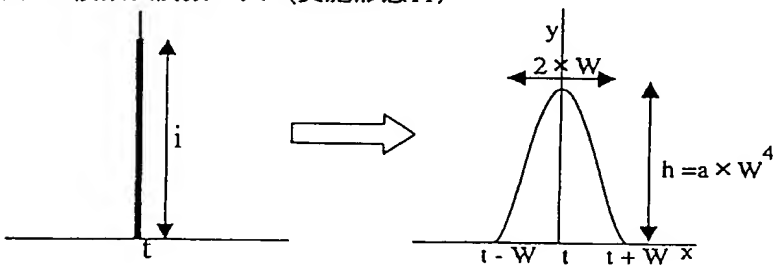
図45 電流波形算出結果(実施形態10)



W＝5 の時

Fig. 46

図46 複数次関数モデル(実施形態11)



W＝一定

$y = a(x - W)^2(x + W)^2$

$a = \frac{15}{16 \times W^5} i$

W＝2.5 , i＝100 の時
a＝0.96
h＝37.5

W＝2.5 , i＝50 の時
a＝0.48
h＝18.75

Fig. 47

図47 電流波形算出処理
ブロック図(実施形態11)

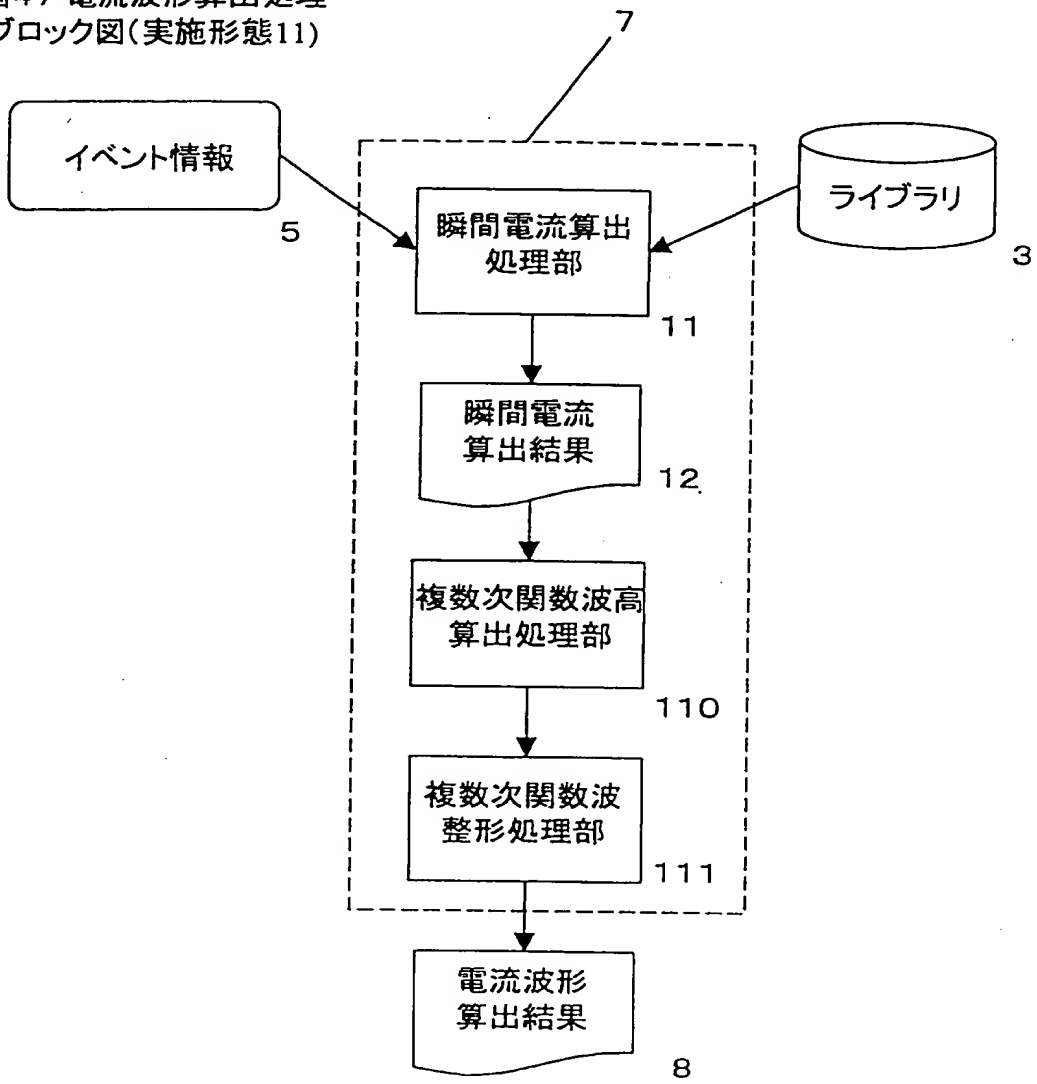


Fig. 48

図48 複数次関数整形処理フロー図

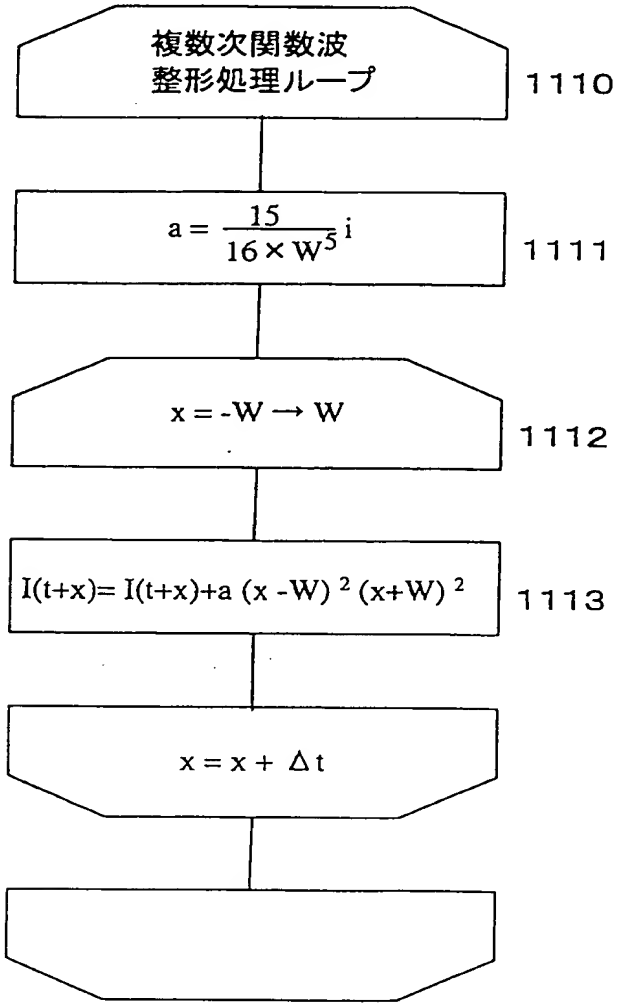
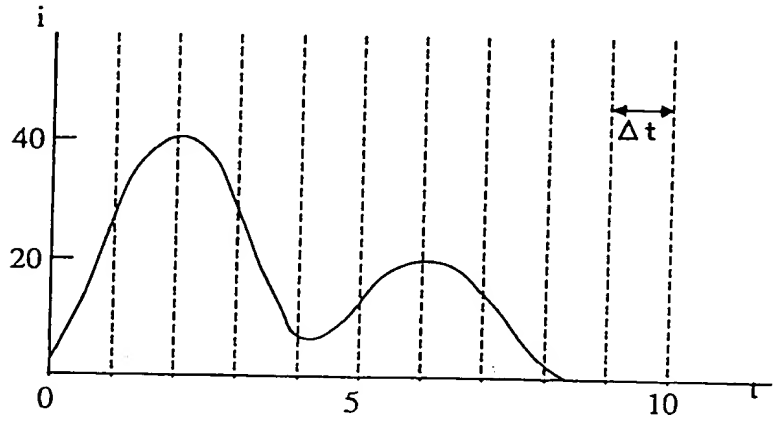


Fig. 49

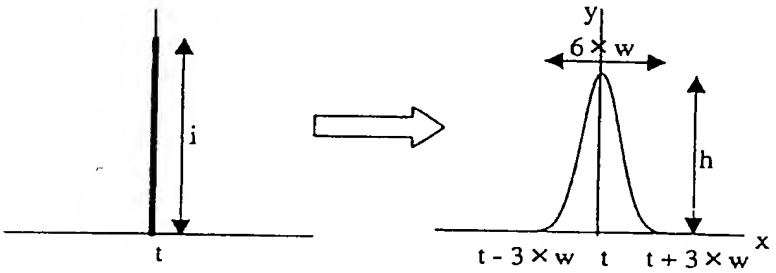
図49 電流波形算出結果(実施形態11)



W＝2.5 の時

Fig. 50

図50 ガウス関数モデル(実施形態12,25)

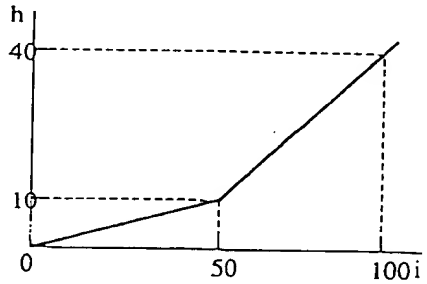


$$y = h \times e^{-\left(\frac{x}{w}\right)^2}$$

Fig. 51

図51 i-hテーブル

i	h
0	0
50	10
100	40



i＝50，100 の場合
(i1,h1)=(50,5)
(i2,h2)=(100,20)

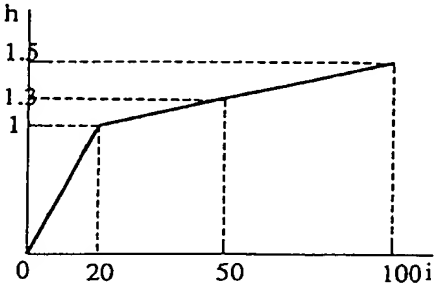
$$h(i) = \frac{h2-h1}{i2-i1}(i-i1)+h1$$

h(50)=10
h(100)=40

Fig. 52

図52 i-wテーブル

i	w
0	0
20	1
100	1.5



i＝50，100の場合
(i1,w1)=(20,1)
(i2,w2)=(100,1.5)

$$w(i)=\frac{w2-w1}{i2-i1}(i-i1)+w1$$

w(50)=1.3
w(100)=1.5

Fig. 53

図53 電流波形算出処理
ブロック図(実施形態12)

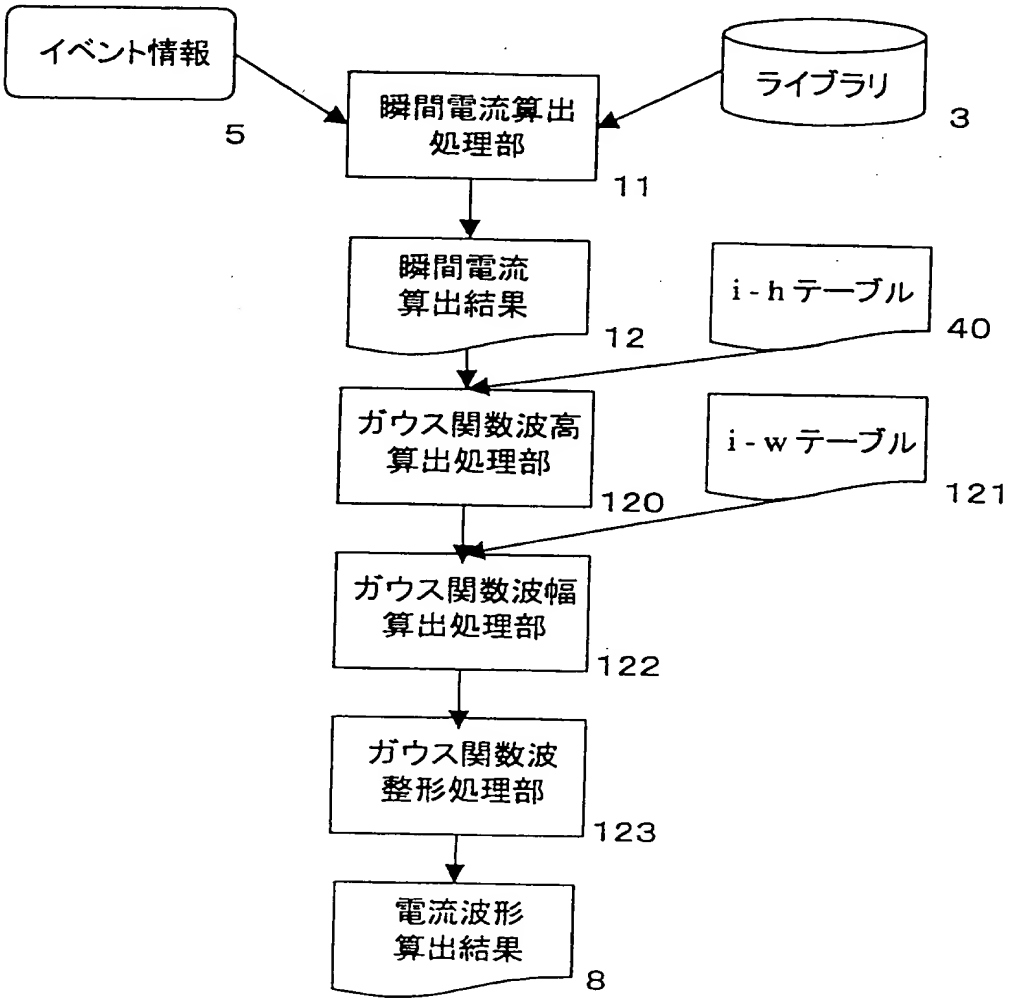


Fig. 54

図54 ガウス波整形処理フロー図

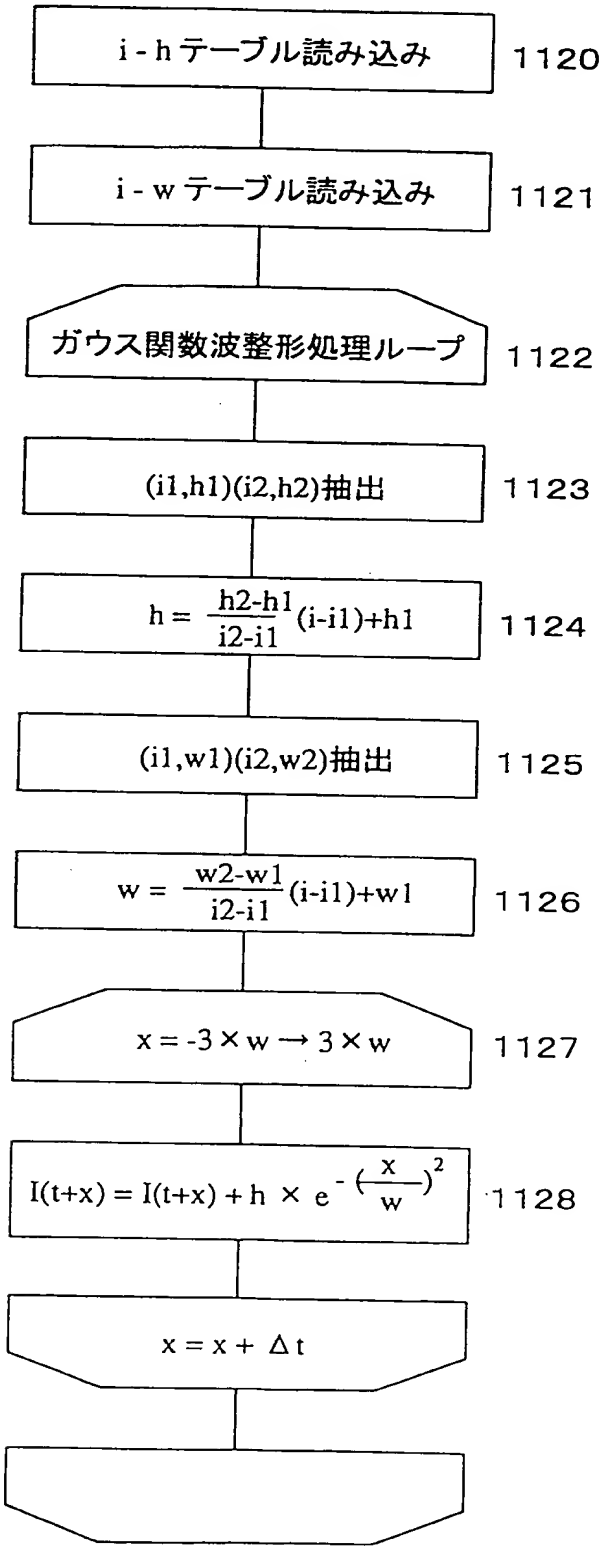


Fig. 55

図55 電流波形算出結果(実施形態12)

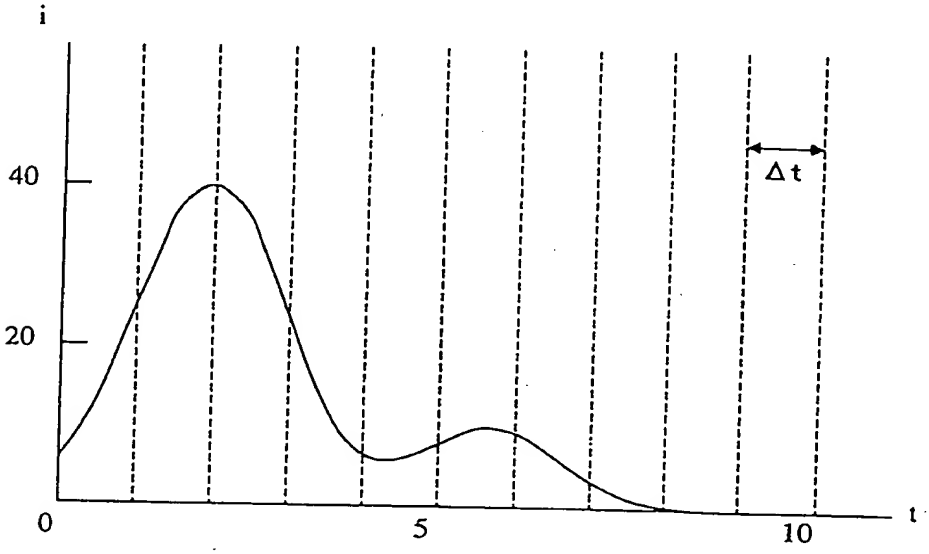


Fig. 56

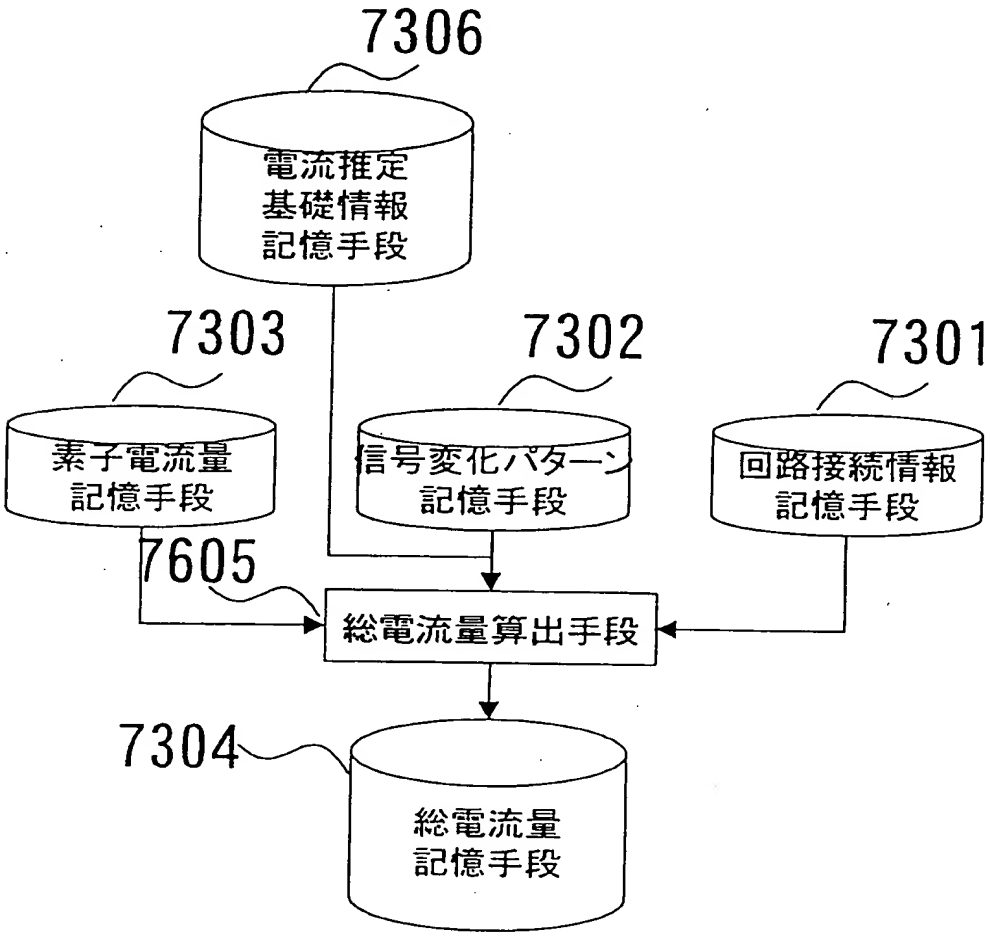


Fig. 57

フリップフロップFF

Y変化時貫通電流成分電流量	2mA	～7401
Y変化時チャージ電流成分電流量	3mA	～7402
CK変化時貫通電流成分電流量	1mA	～7403
CK変化時チャージ電流成分電流量	1mA	～7404

バッファBUF

Y変化時貫通電流成分電流量	0.5mA	～7405
Y変化時チャージ電流成分電流量	0.5mA	～7406

Fig. 58

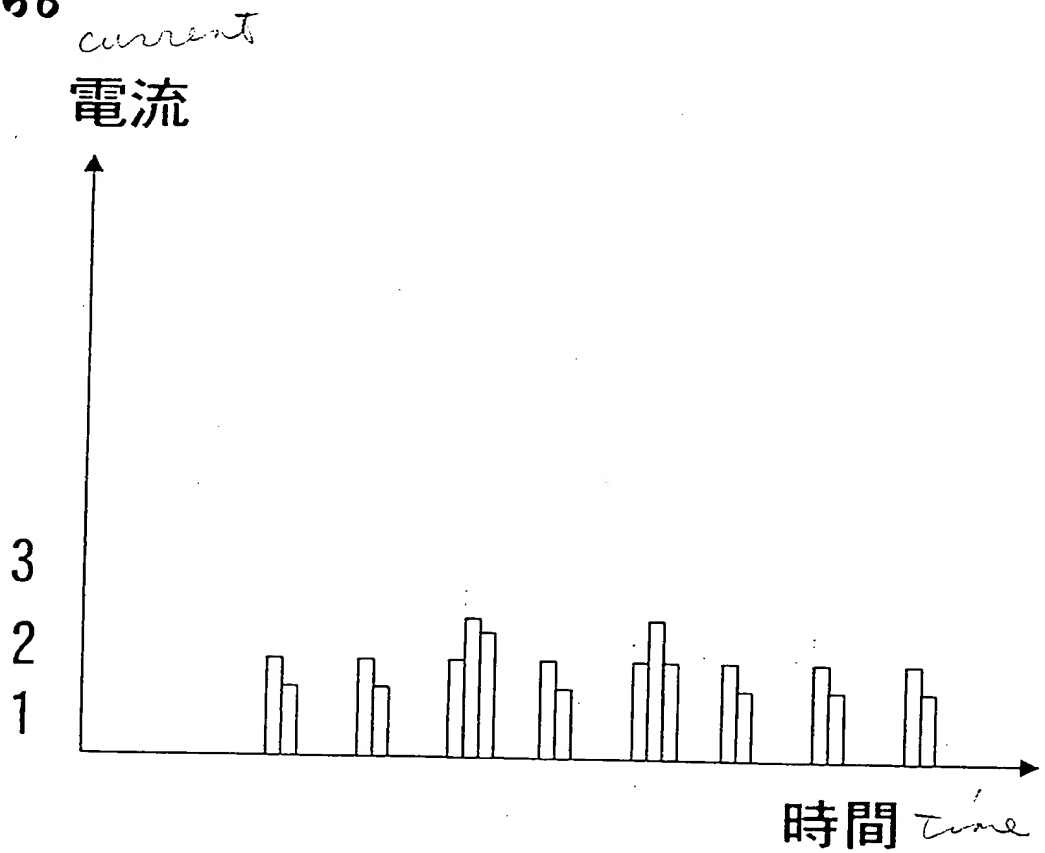


Fig. 59

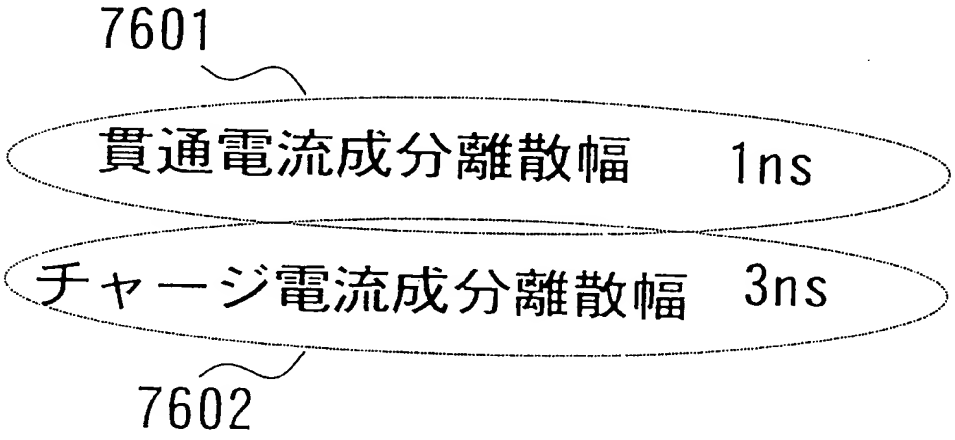


Fig. 60

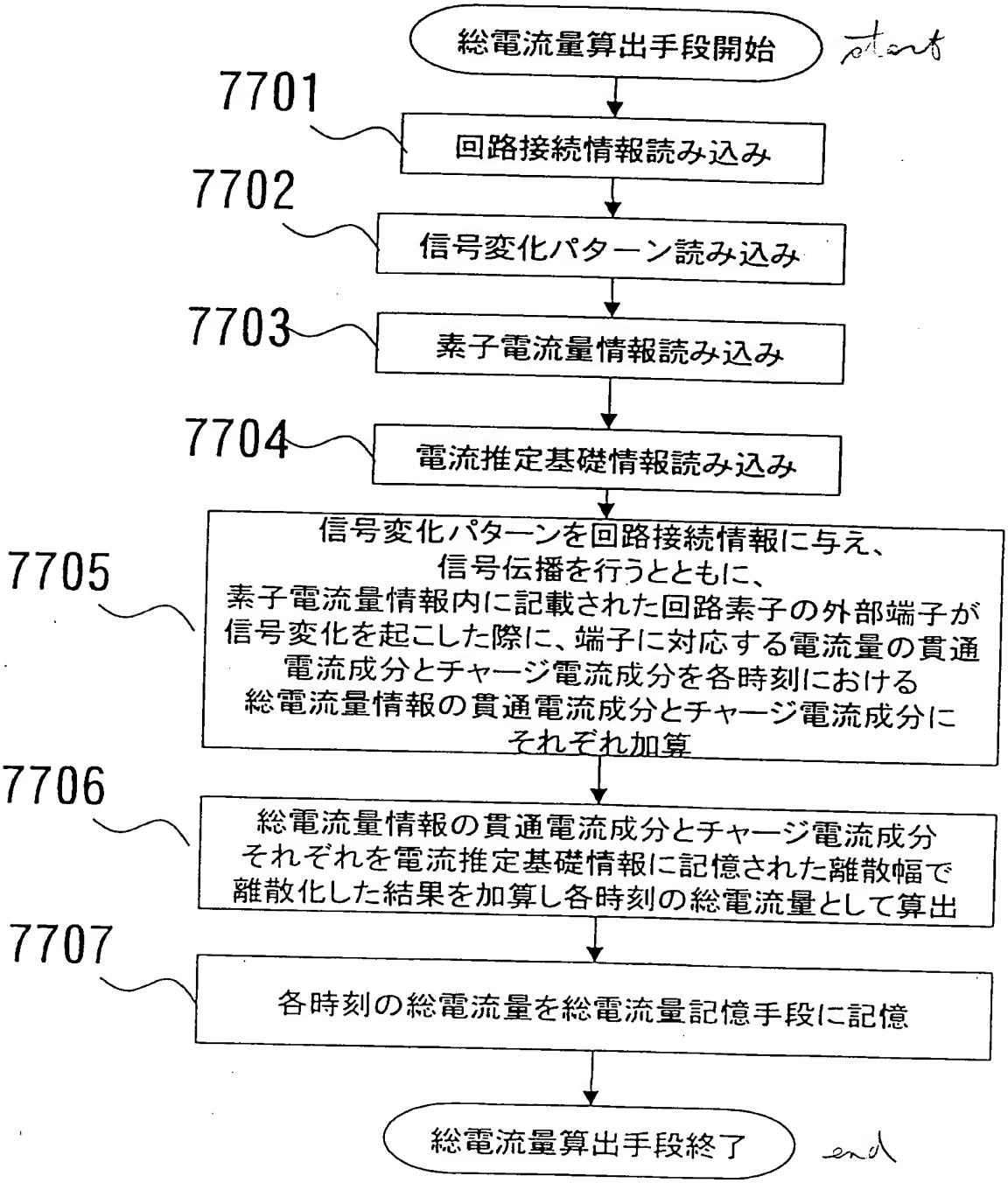


Fig. 61

図61 電流波形算出処理
ブロック図(実施形態14)

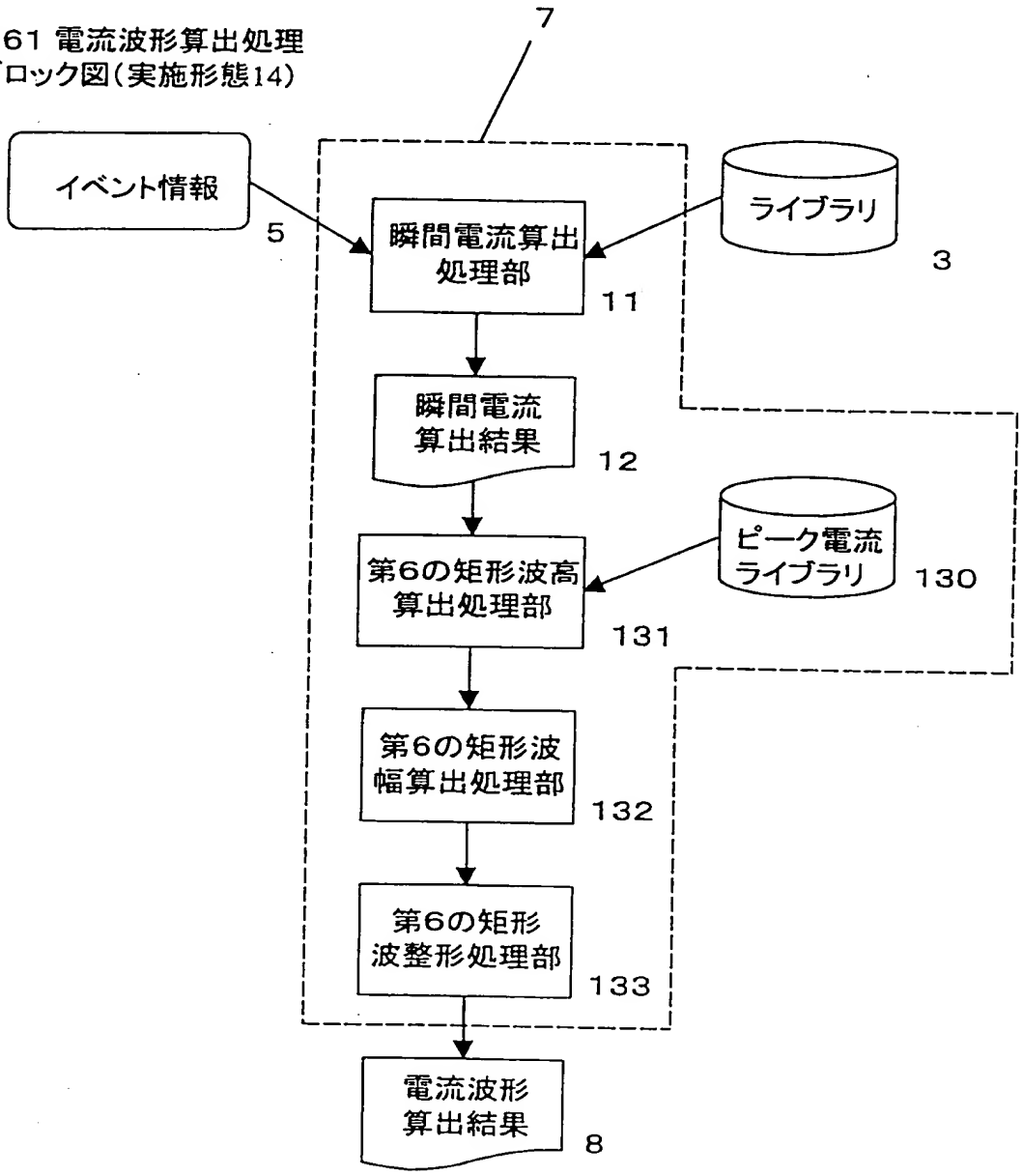


Fig. 62

図62 第6の矩形波整形処理フロー図

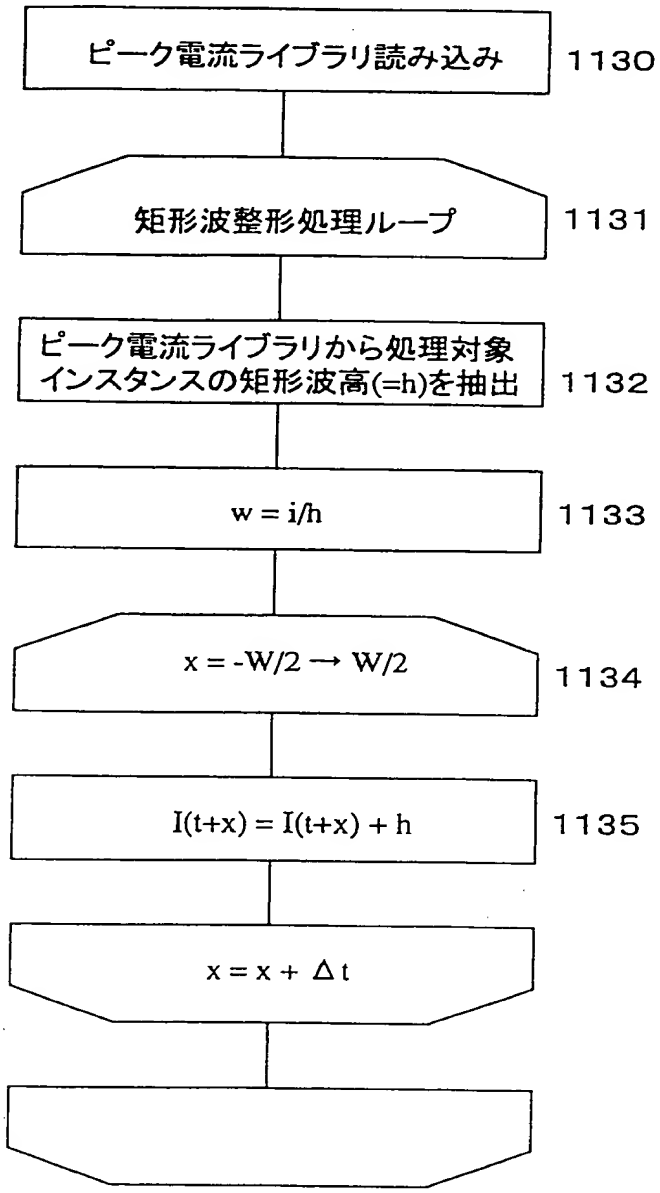
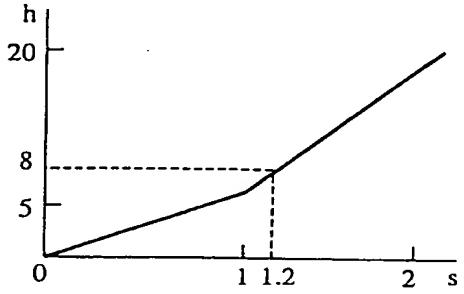


Fig. 63

図63 s - h テーブル

s	h
0	0
1	5
2	20



s = 1.2 の場合
(s1,h1)=(1,5)
(s2,h2)=(2,20)

$$h(s)=\frac{h2-h1}{s2-s1}(s-s1)+h1$$

h(1.2)=8

Fig. 64

図64 電流波形算出処理
ブロック図(実施形態15)

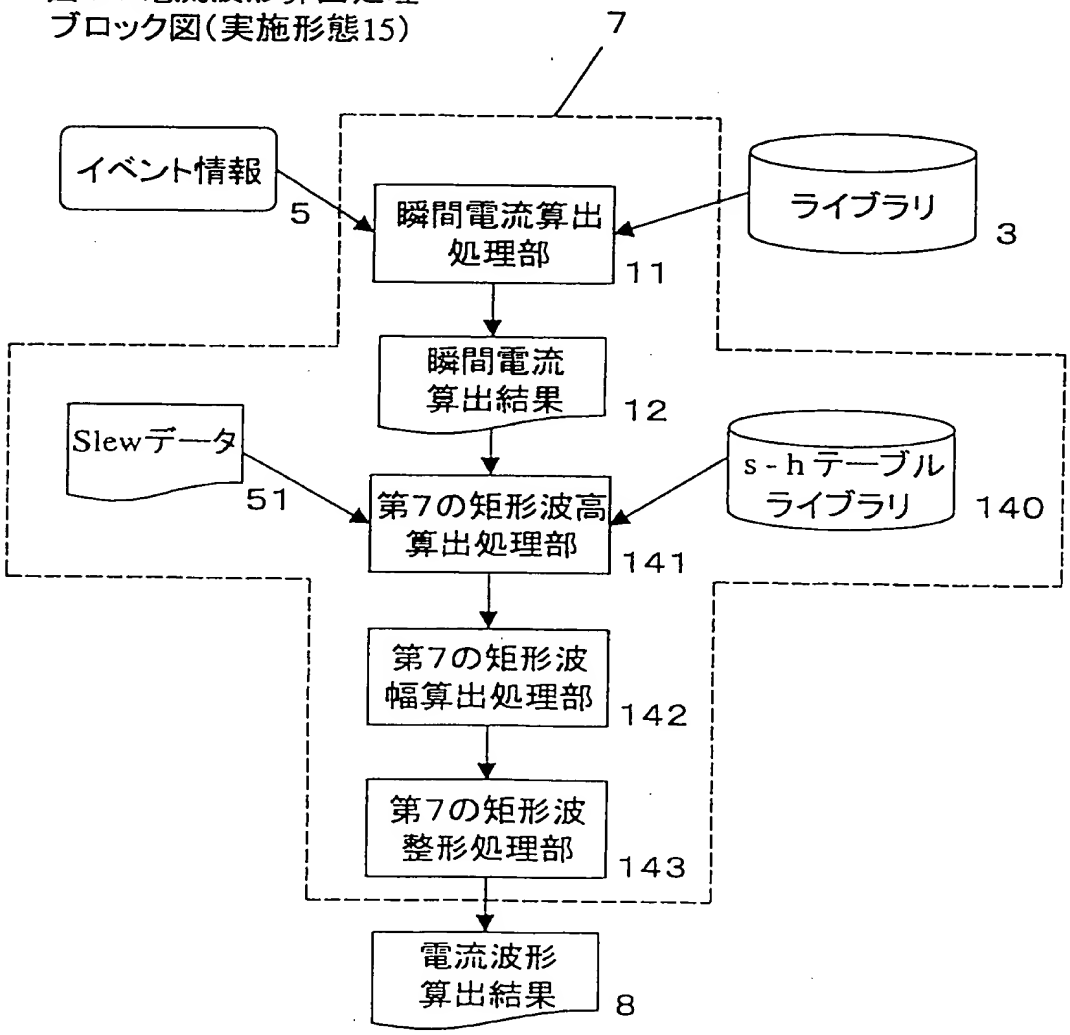


Fig. 65

図65 第7の矩形波整形処理フロー図

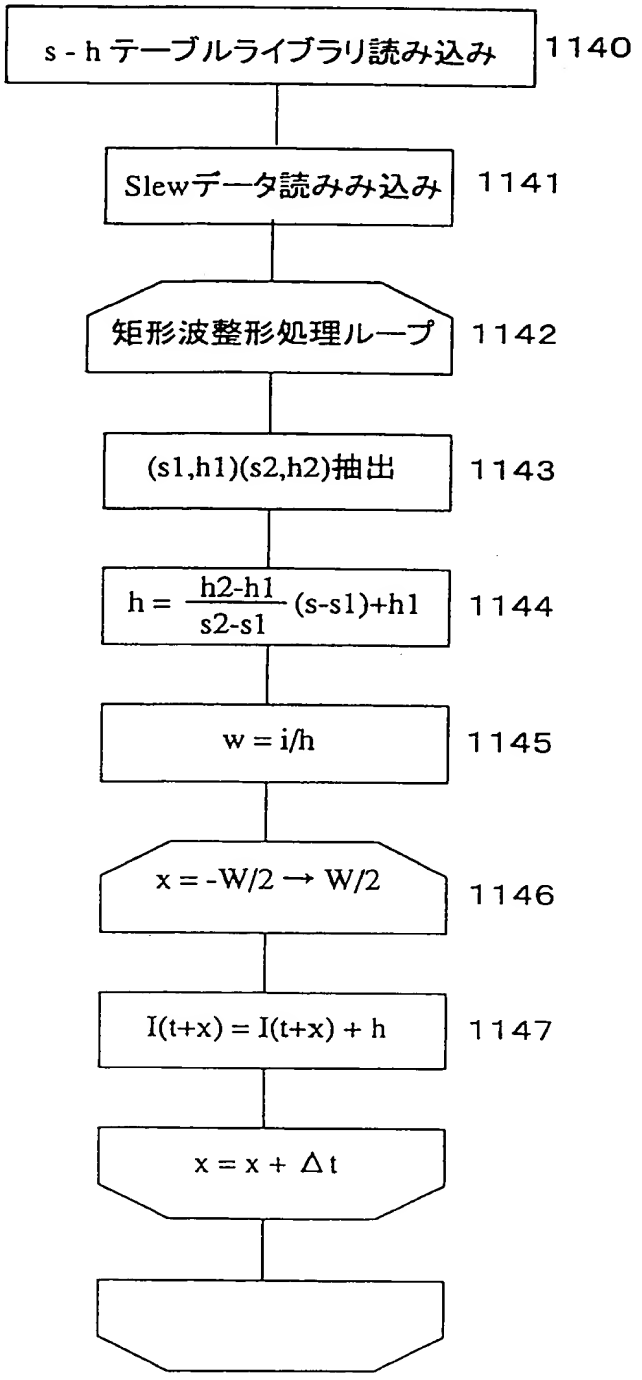
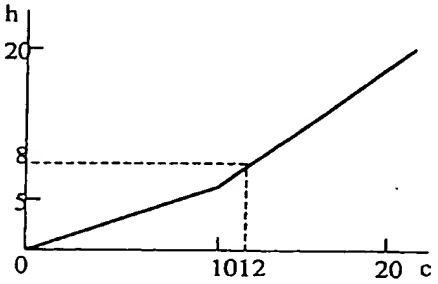


Fig. 66

図66 c - h テーブル

c	h
0	0
10	5
20	20



c = 12 の場合
(c1,h1)=(10,5)
(c2,h2)=(20,20)

$$h(c)=\frac{h2-h1}{c2-c1}(c-c1)+h1$$

h(12)=8

Fig. 67

図67 電流波形算出処理
ブロック図(実施形態16)

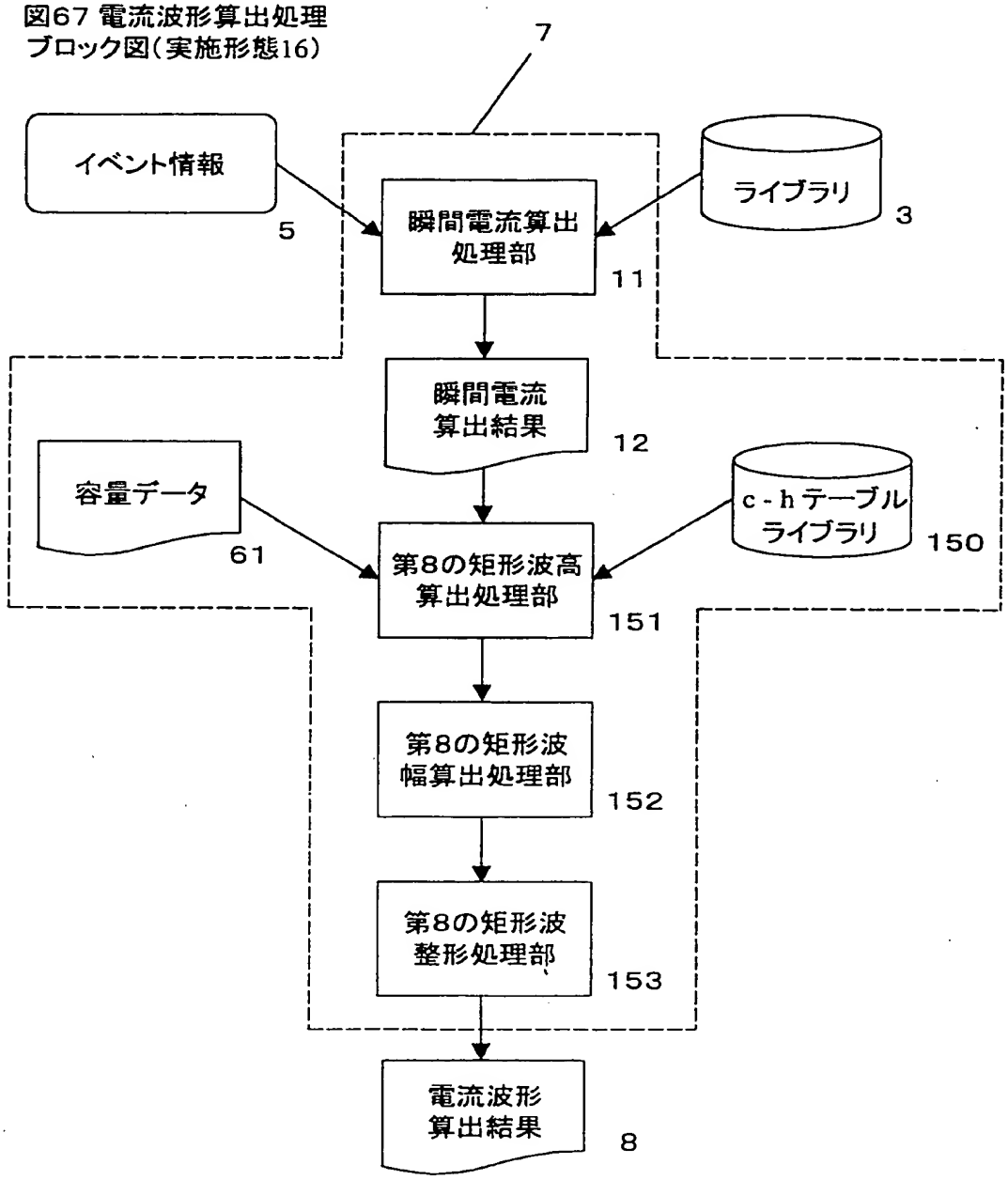


Fig. 68

図68 第8の矩形波整形処理フロー図

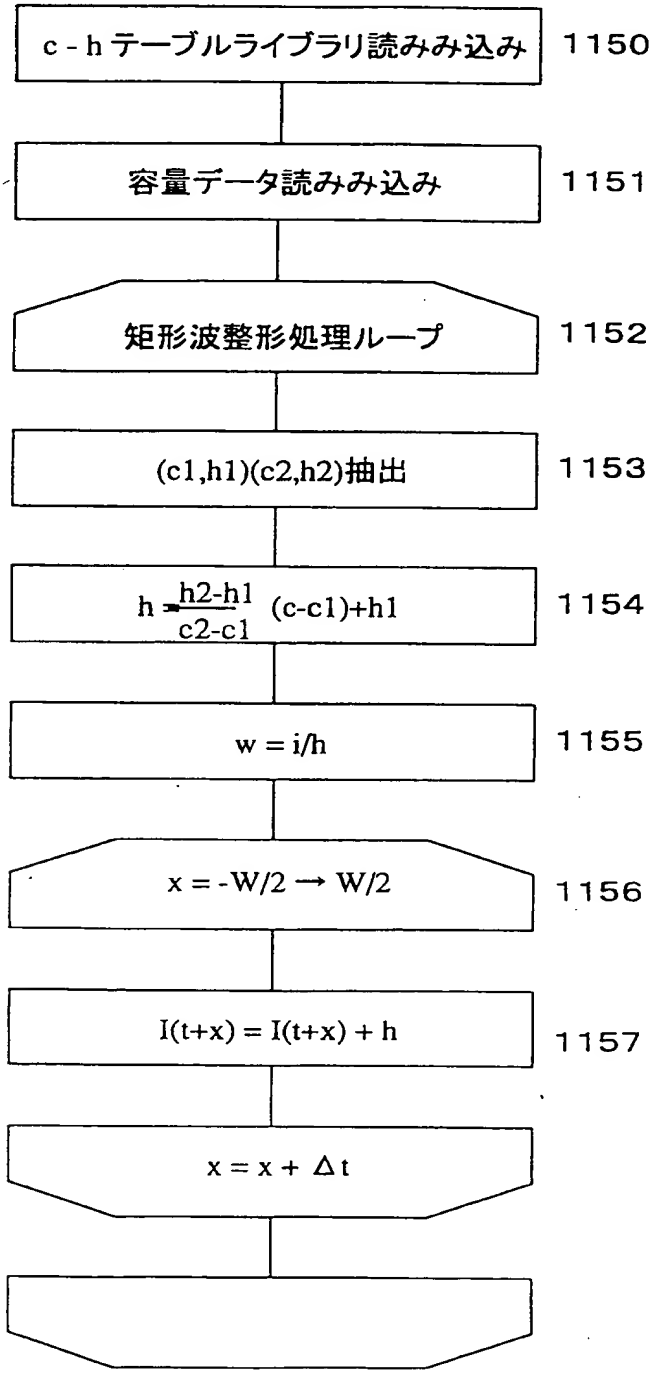


Fig. 69

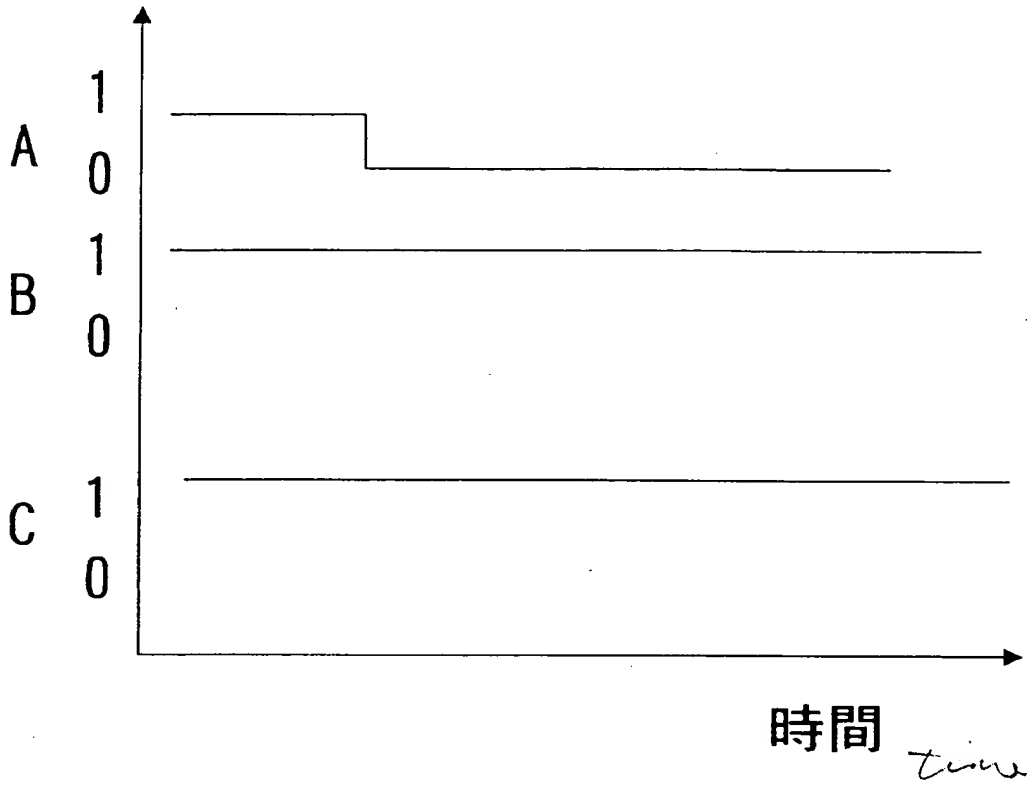


Fig. 70

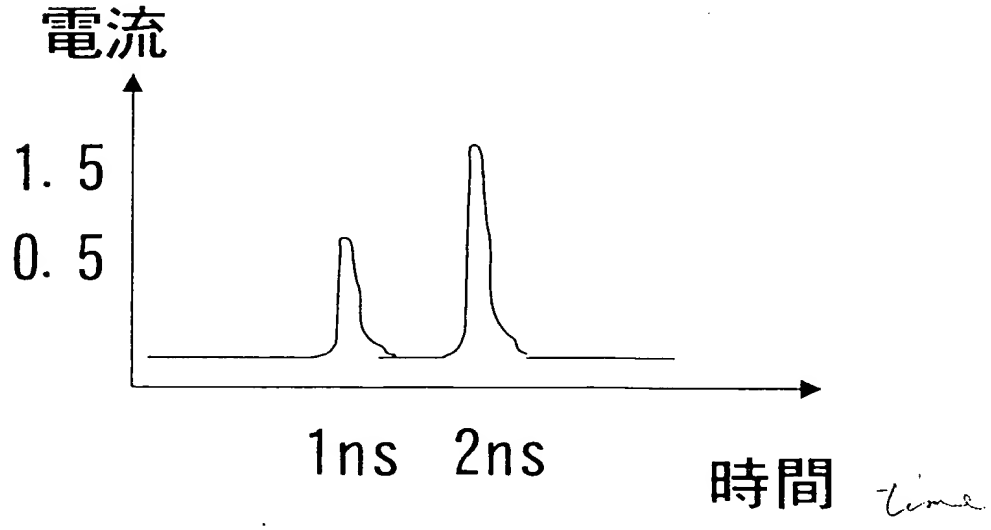


Fig. 71

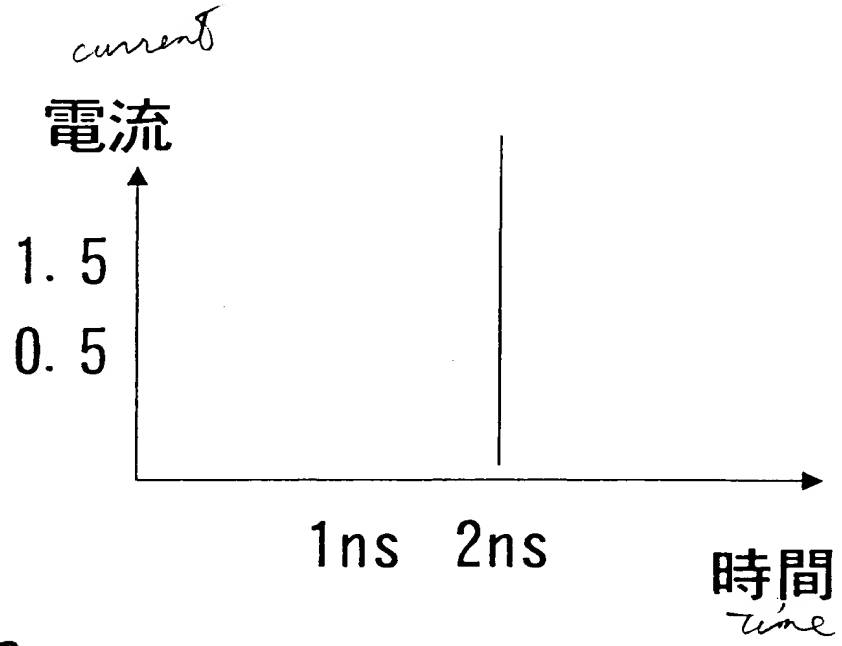


Fig. 72

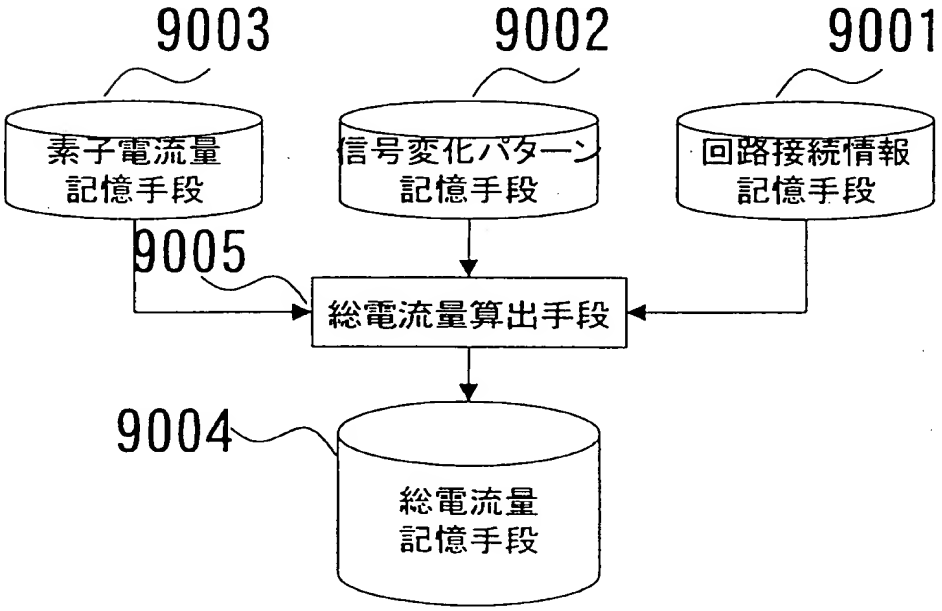


Fig. 73

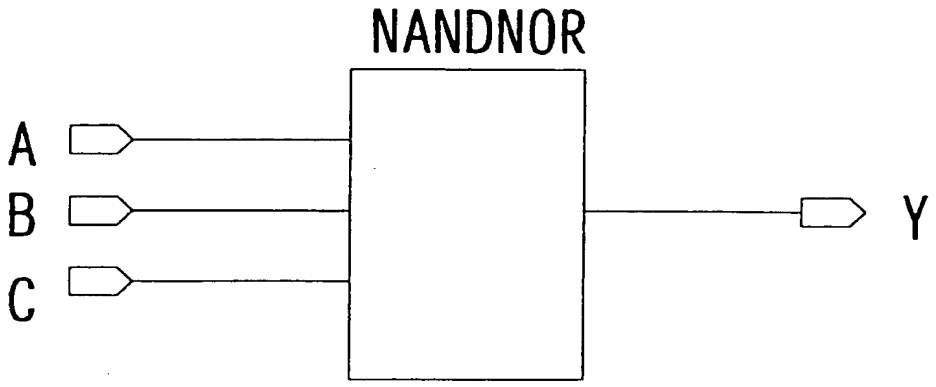


Fig. 74

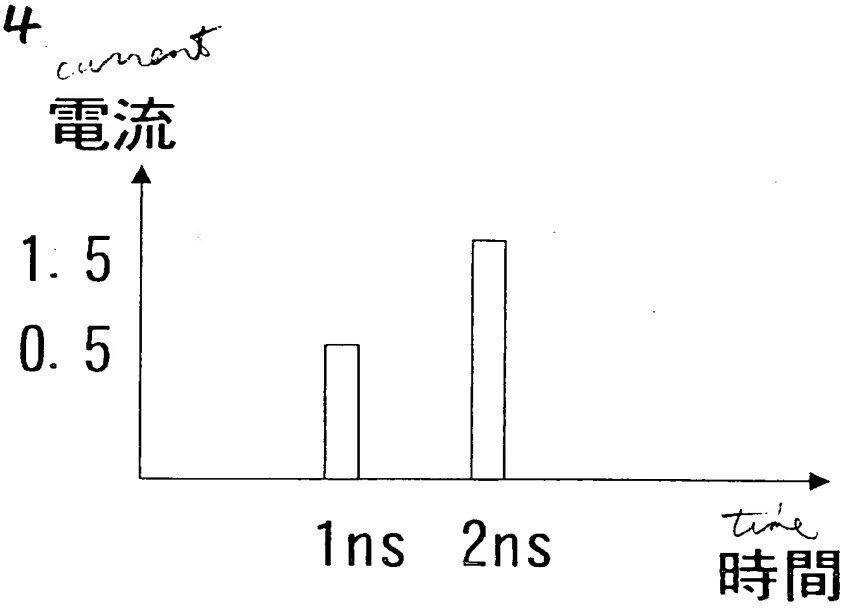


Fig. 75

NANDNOR

9301 変化ピン	9302 時間	9303 電流総量	9304 ピーク	
A	1ns	1mA	0.5mA	9305
A	2ns	3mA	1.5mA	
B	1ns	1mA	0.5mA	9306
B	2ns	3mA	1.5mA	
C	1ns	3mA	1.5mA	9307

Fig. 76

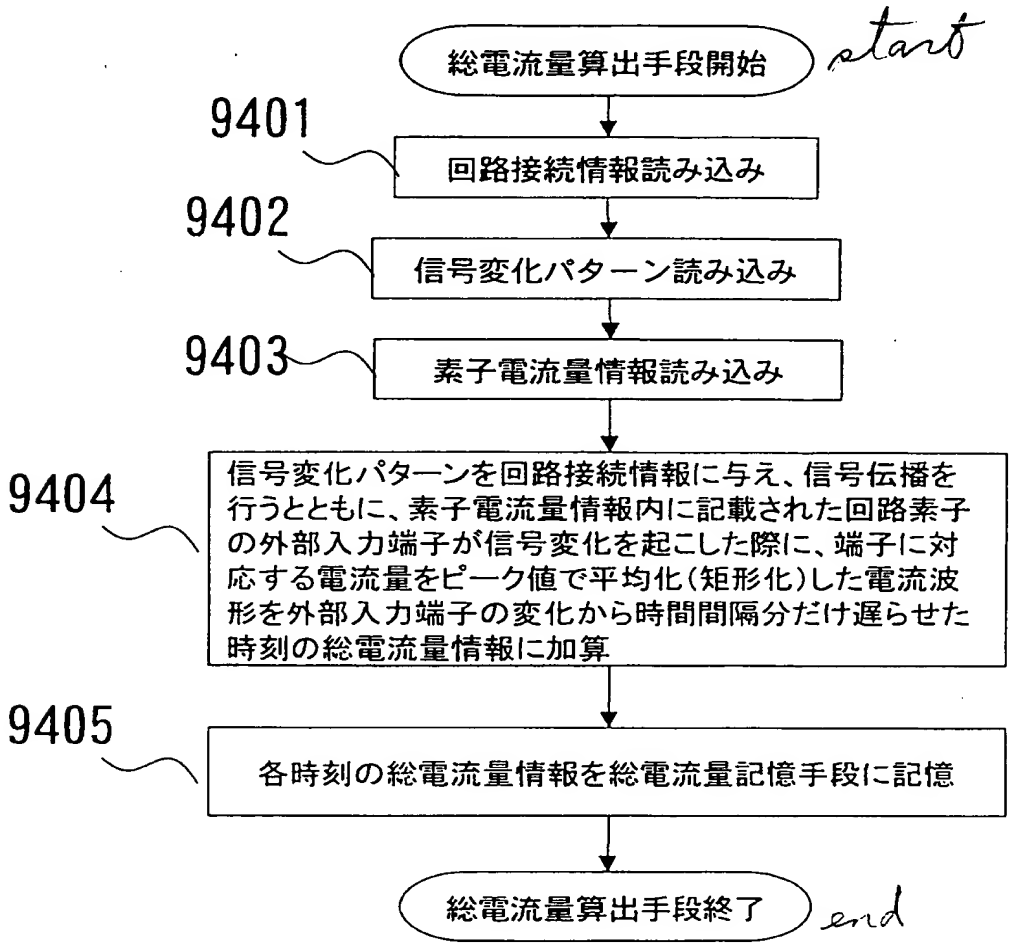


Fig. 77

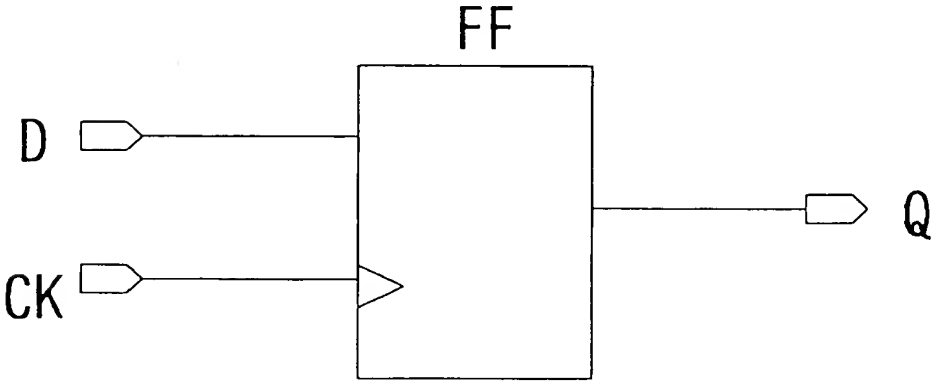


Fig. 78

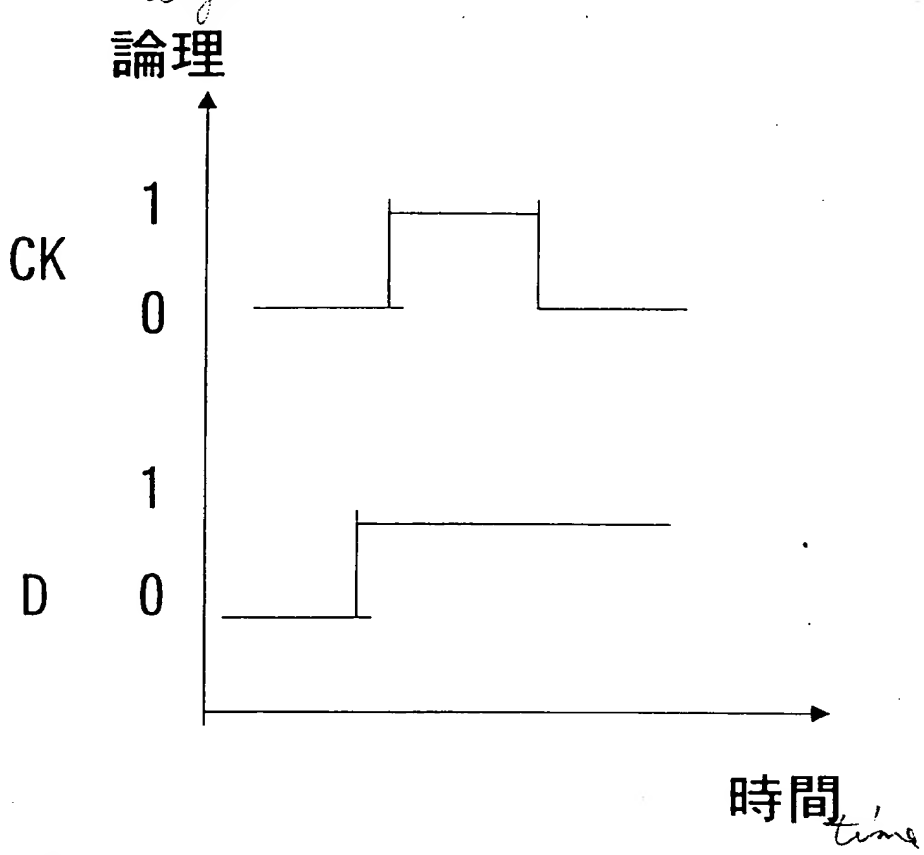


Fig. 79

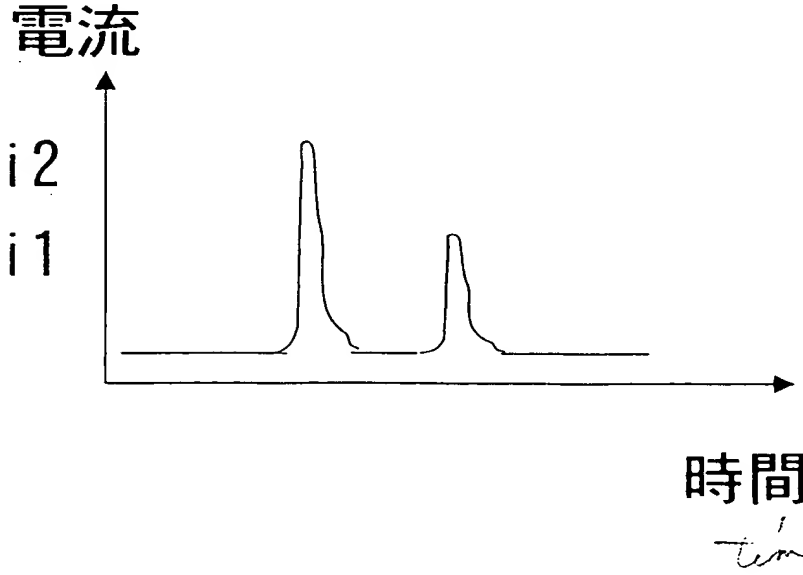


Fig. 80.

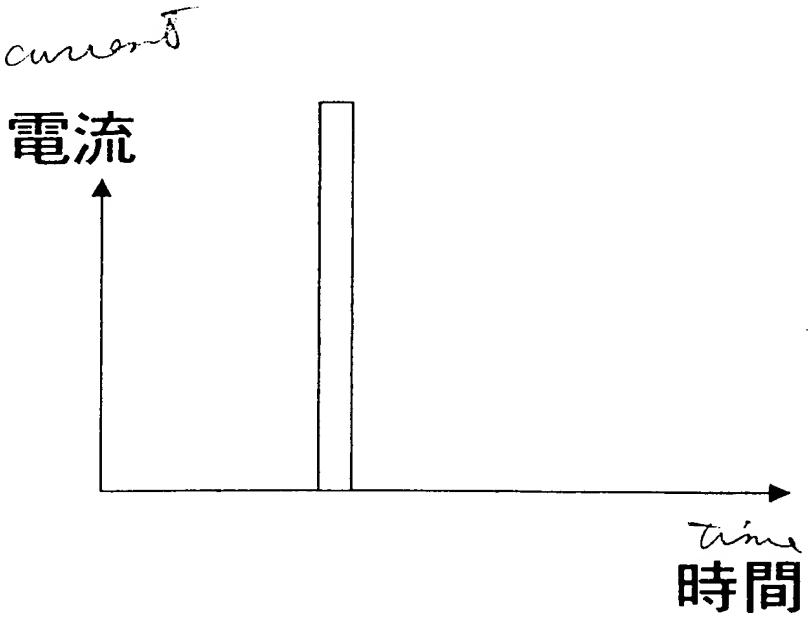


Fig. 81

FF	edge エッジ	current 電流	peak value ピーク値
	rise	15mA	7.5mA
	fall	5mA	2.5mA

9901　9902

Fig. 82

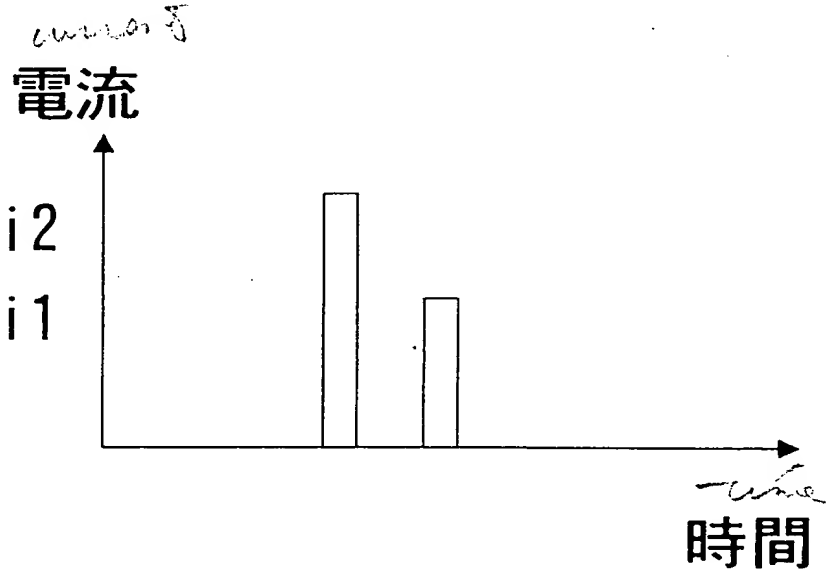


Fig. 83

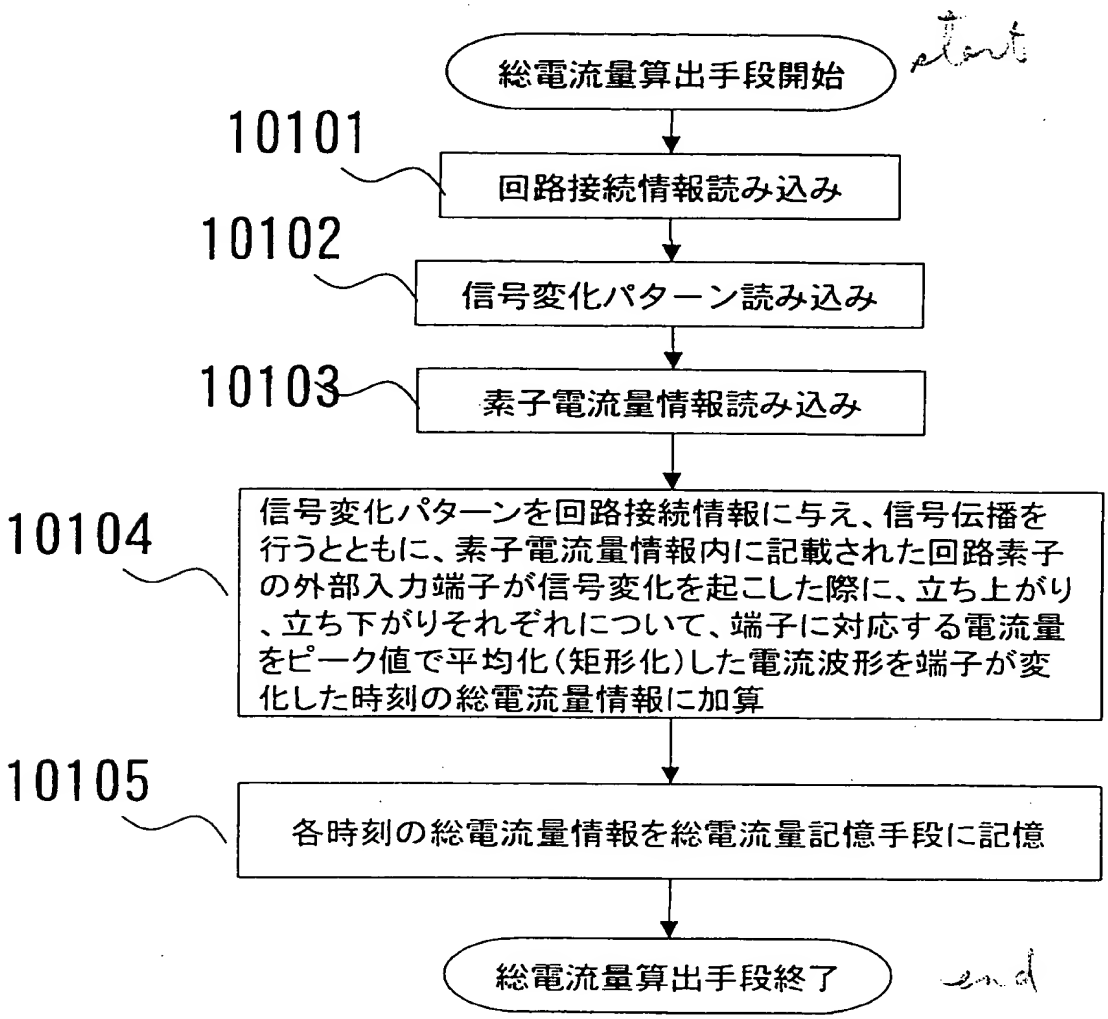


Fig. 84

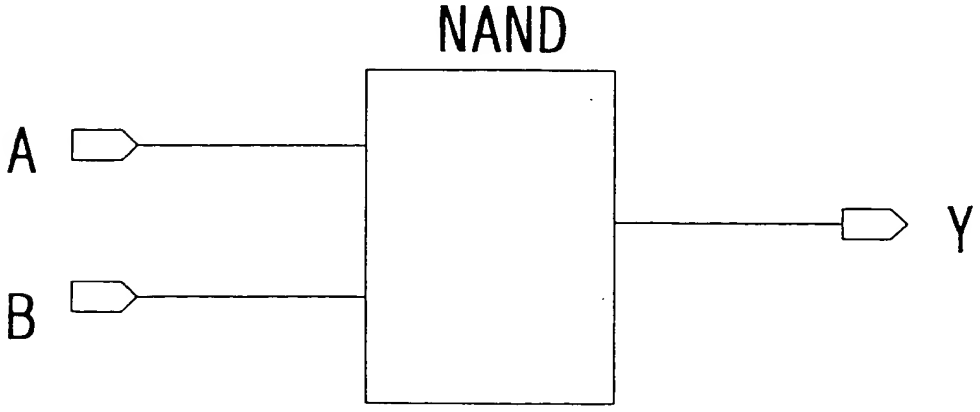


Fig. 85

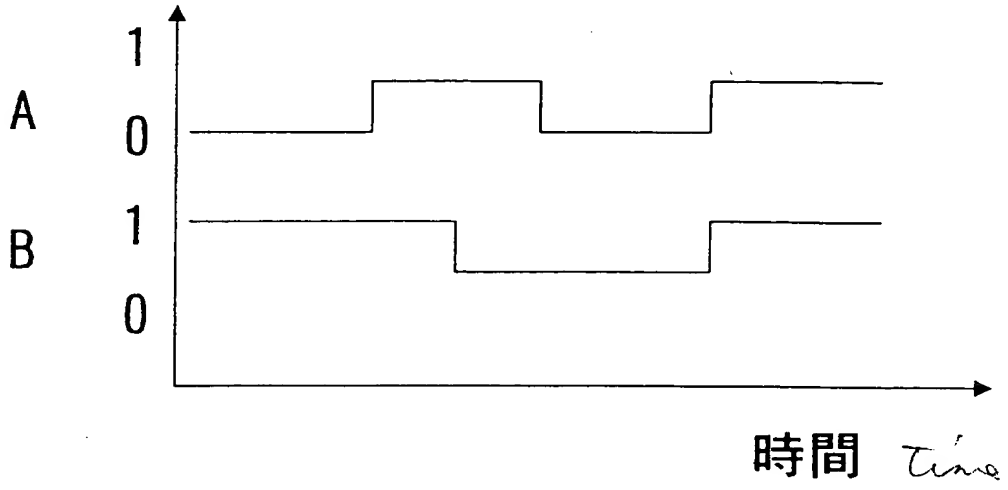


Fig. 86

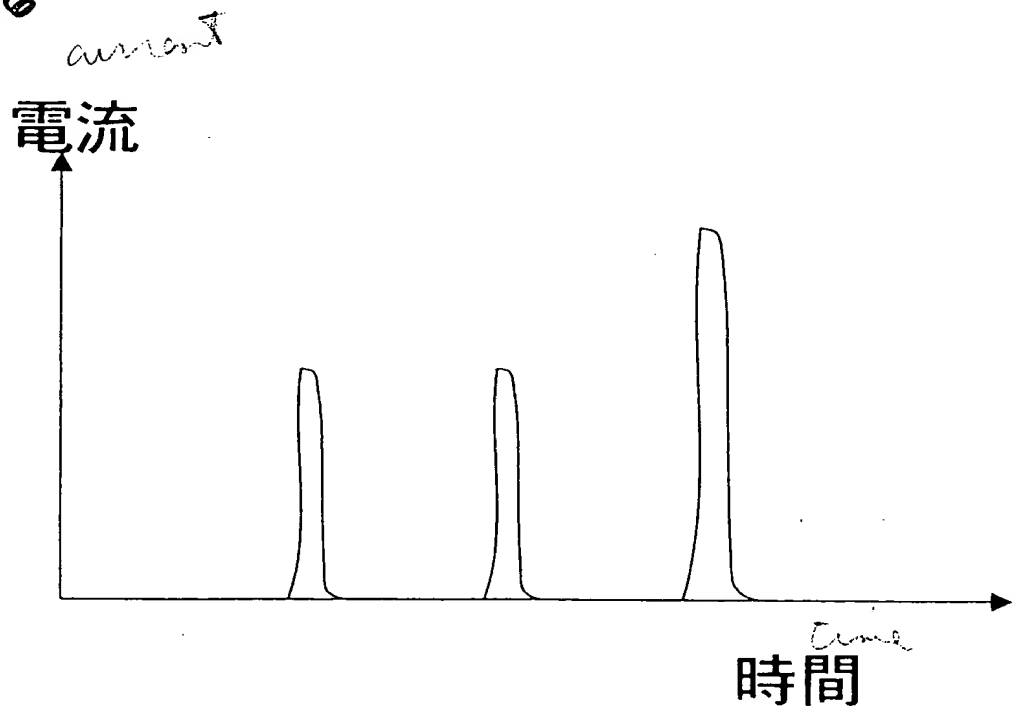
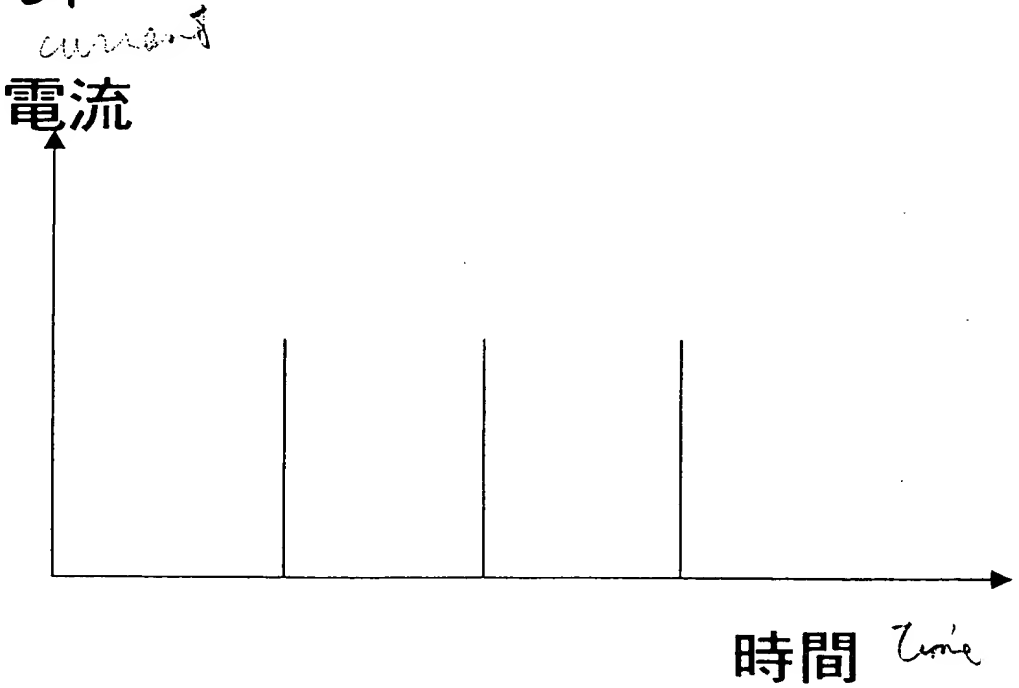


Fig. 87



論理和否定 NAND Y端子　10601

A=1, B=0→1時の電流総量	3mA
A=1, B=0→1時のピーク値	1mA
A=1, B=1→0時の電流総量	3mA
A=1, B=1→0時のピーク値	1mA
B=1, A=0→1時の電流総量	3mA
B=1, A=0→1時のピーク値	1mA
B=1, A=1→0時の電流総量	3mA
B=1, A=1→0時のピーク値	1mA
A=0→1, B=0→1時の電流総量	4mA
A=0→1, B=0→1時のピーク値	1.5mA
A=1→0, B=1→0時の電流総量	4mA
A=1→0, B=1→0時のピーク値	1.5mA

Fig 89

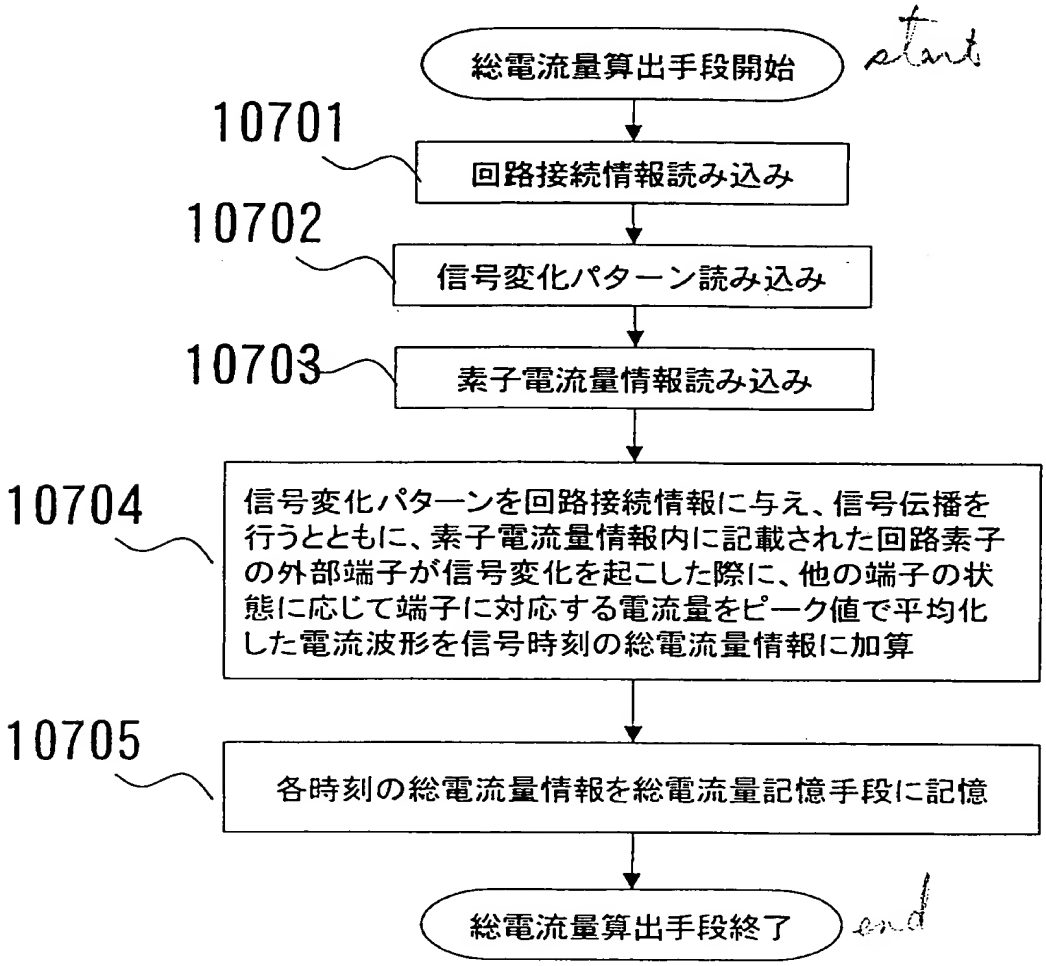


Fig. 90

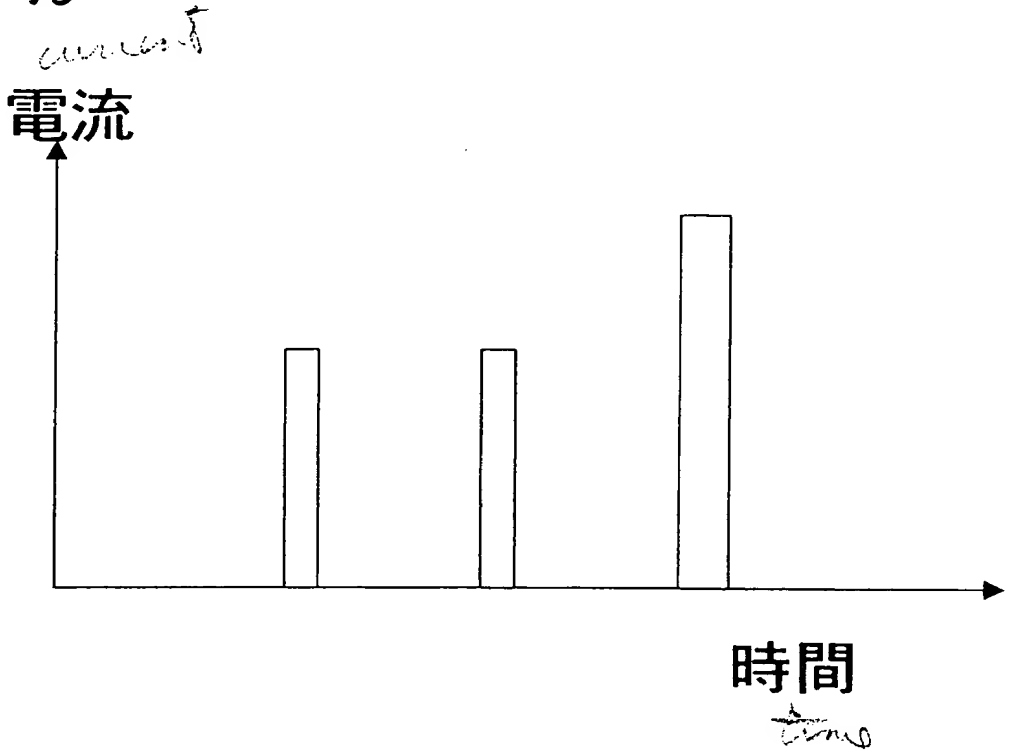


Fig. 91

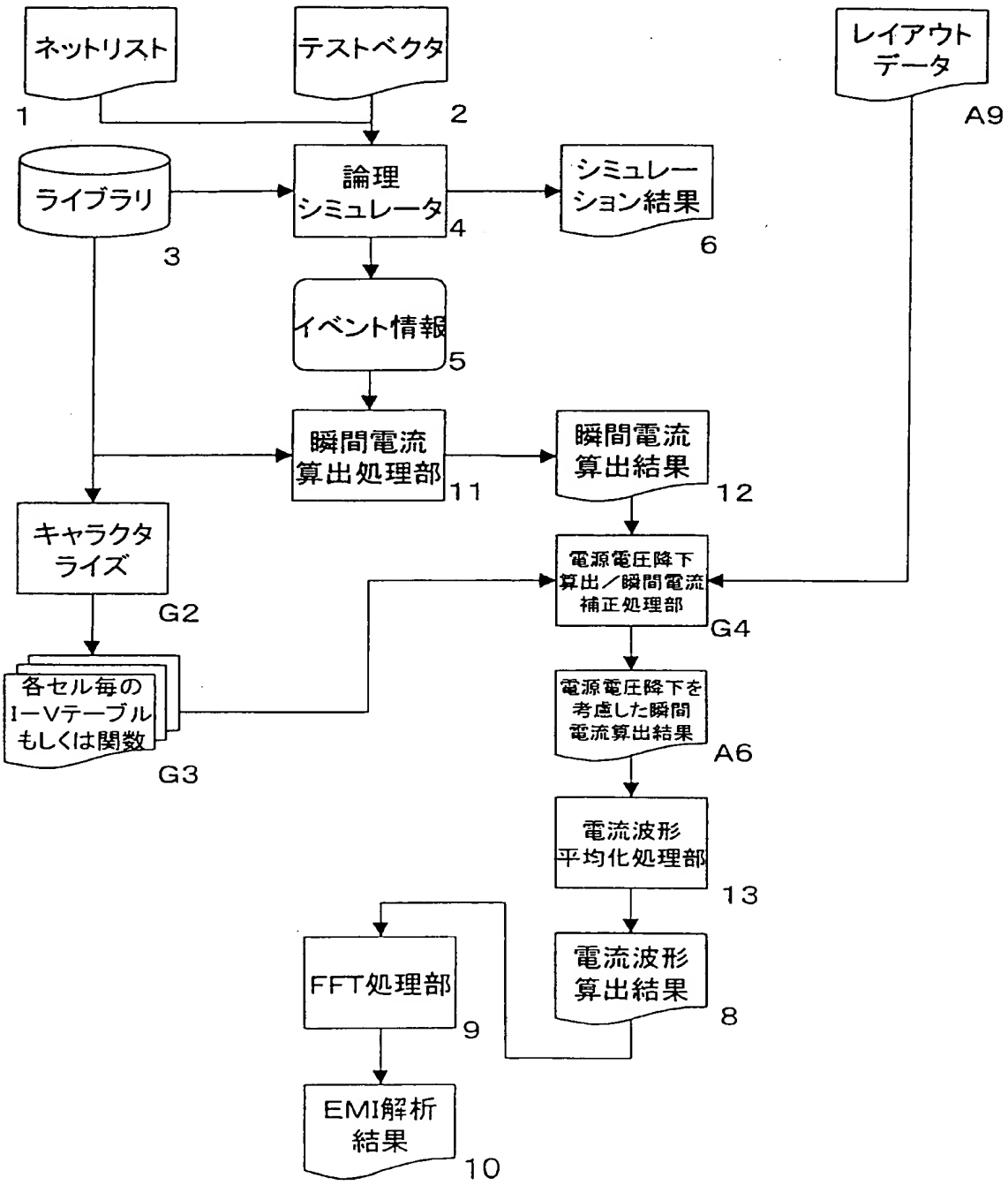


Fig. 92

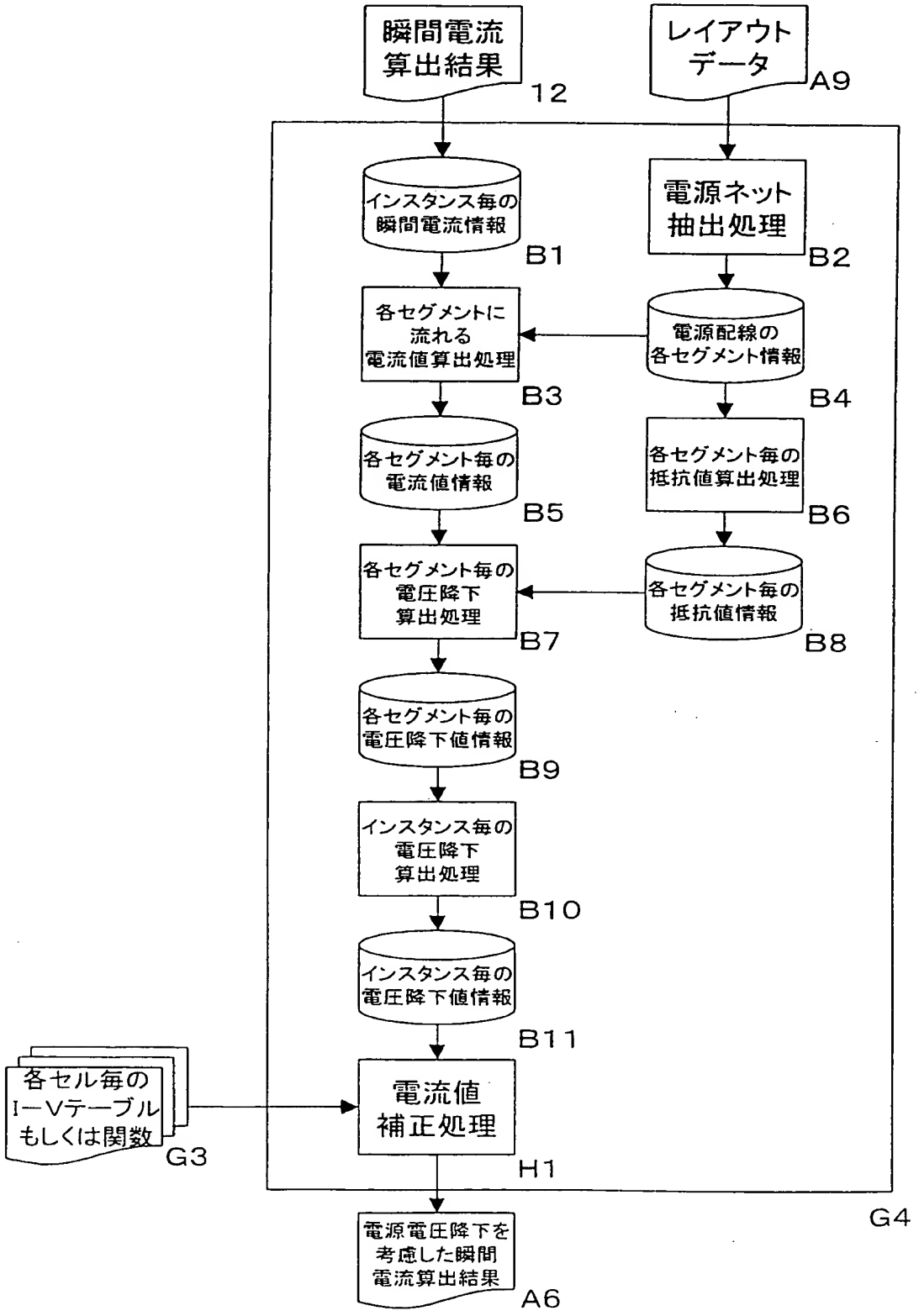

瞬間電流
算出結果
12
レイアウト
データ
A9
インスタンス毎の
瞬間電流情報
B1
電源ネット
抽出処理
B2
各セグメントに
流れる
電流値算出処理
B3
電源配線の
各セグメント情報
B4
各セグメント毎の
電流値情報
B5
各セグメント毎の
抵抗値算出処理
B6
各セグメント毎の
電圧降下
算出処理
B7
各セグメント毎の
抵抗値情報
B8
各セグメント毎の
電圧降下値情報
B9
インスタンス毎の
電圧降下
算出処理
B10
インスタンス毎の
電圧降下値情報
B11
各セル毎の
I－Vテーブル
もしくは関数
G3
電流値
補正処理
H1
G4
電源電圧降下を
考慮した瞬間
電流算出結果
A6

Fig. 93

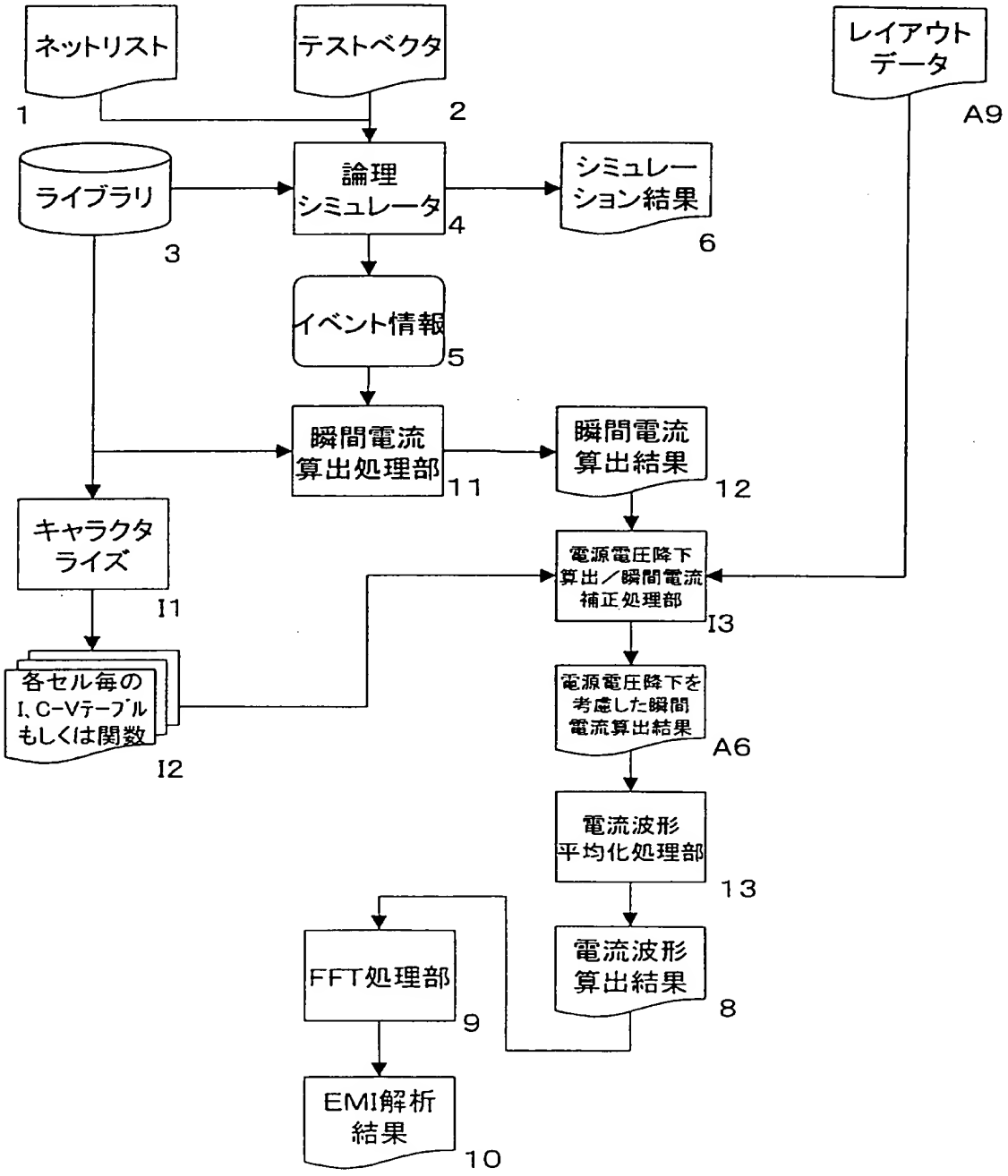

ネットリスト
1
テストベクタ
2
レイアウトデータ
A9
ライブラリ
3
論理シミュレータ
4
シミュレーション結果
6
イベント情報
5
瞬間電流算出処理部
11
瞬間電流算出結果
12
キャラクタライズ
I1
電源電圧降下算出／瞬間電流補正処理部
I3
各セル毎のI、C-Vテーブルもしくは関数
I2
電源電圧降下を考慮した瞬間電流算出結果
A6
電流波形平均化処理部
13
FFT処理部
9
電流波形算出結果
8
EMI解析結果
10

Fig.94

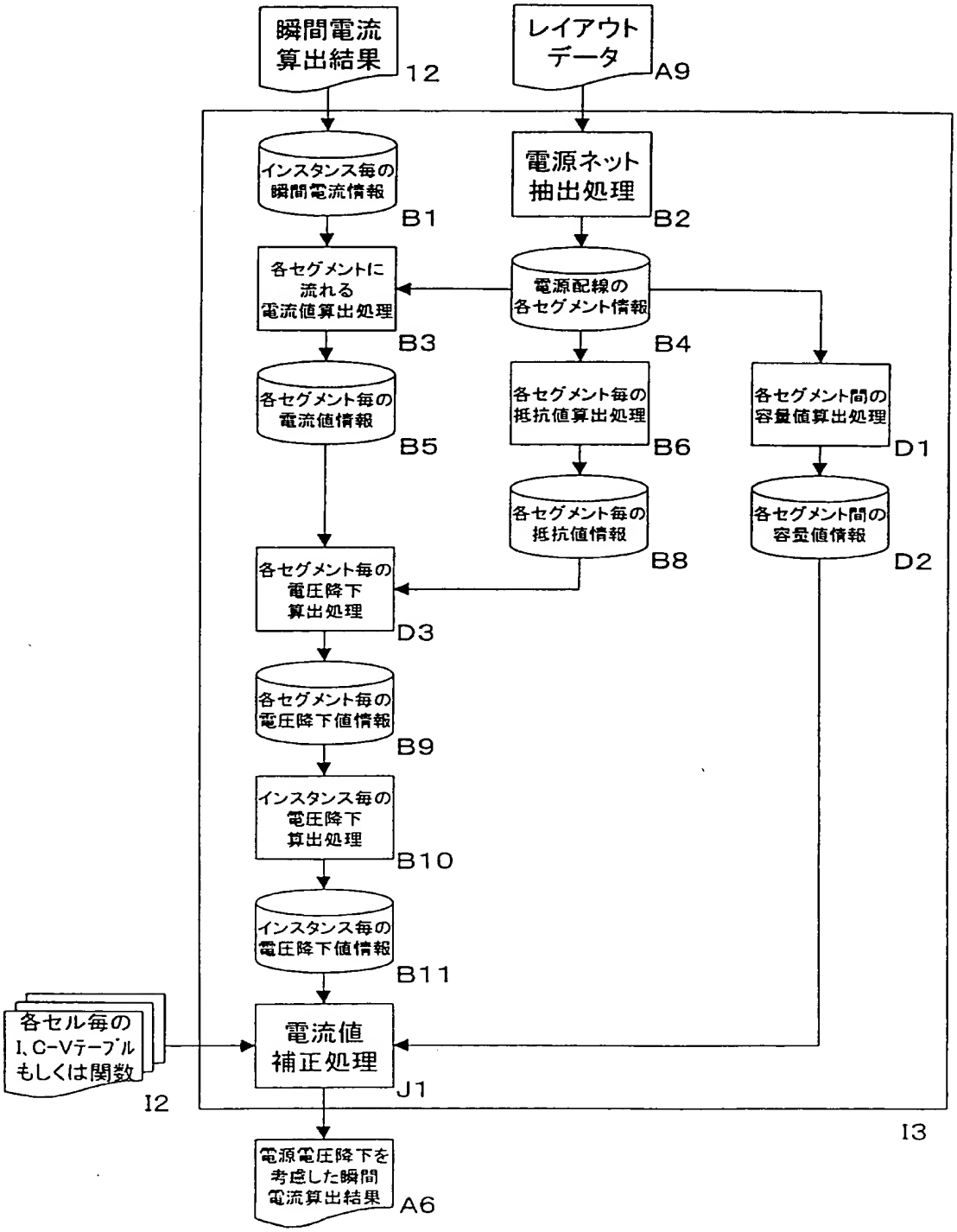

瞬間電流
算出結果
I2
レイアウト
データ
A9
インスタンス毎の
瞬間電流情報
B1
電源ネット
抽出処理
B2
各セグメントに
流れる
電流値算出処理
B3
電源配線の
各セグメント情報
B4
各セグメント毎の
電流値情報
B5
各セグメント毎の
抵抗値算出処理
B6
各セグメント間の
容量値算出処理
D1
各セグメント毎の
抵抗値情報
B8
各セグメント間の
容量値情報
D2
各セグメント毎の
電圧降下
算出処理
D3
各セグメント毎の
電圧降下値情報
B9
インスタンス毎の
電圧降下
算出処理
B10
インスタンス毎の
電圧降下値情報
B11
各セル毎の
I、C-Vテーブル
もしくは関数
I2
電流値
補正処理
J1
I3
電源電圧降下を
考慮した瞬間
電流算出結果
A6

Fig. 95

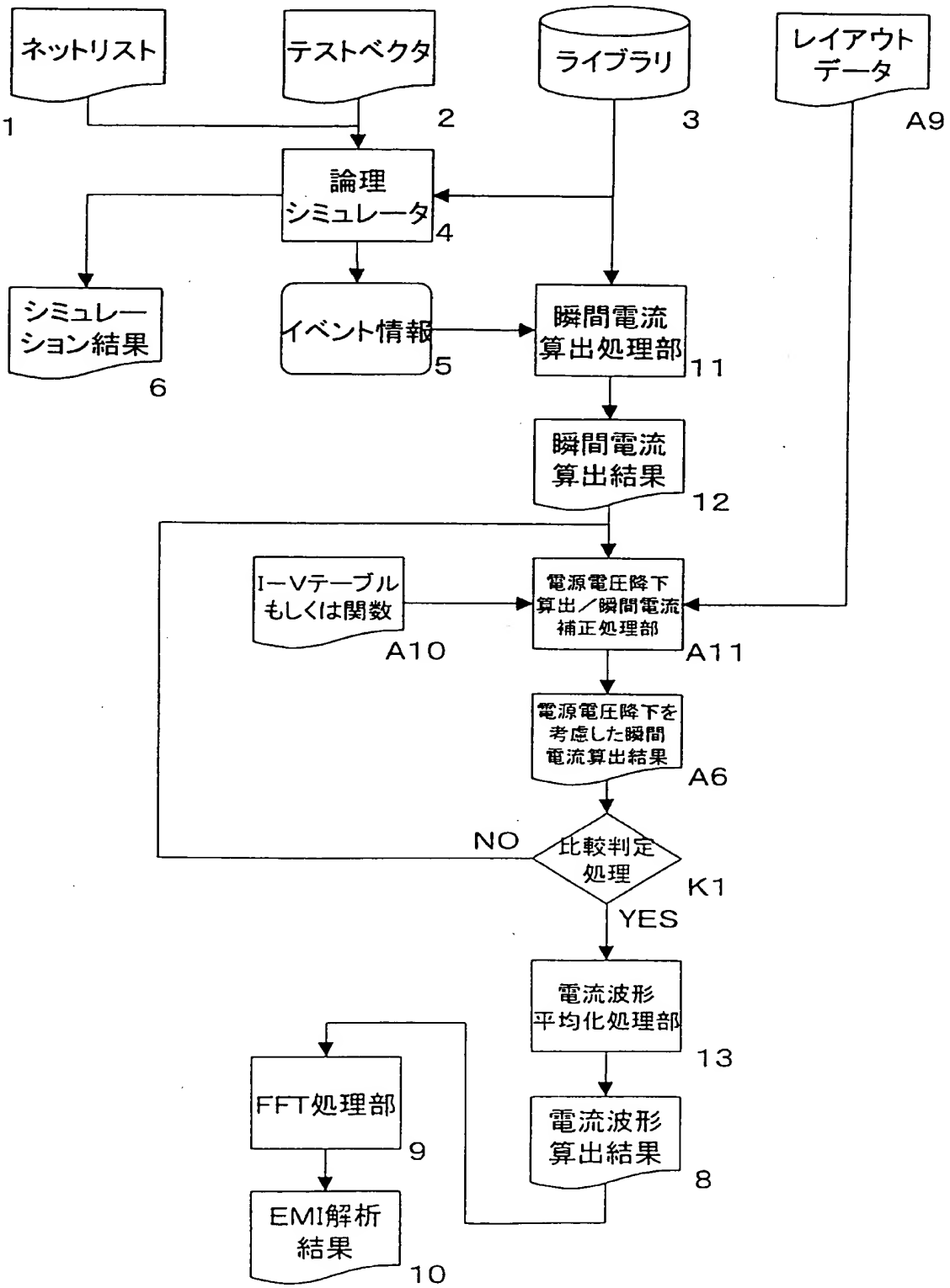


Fig. 96

図96 三角波モデル(実施形態23)

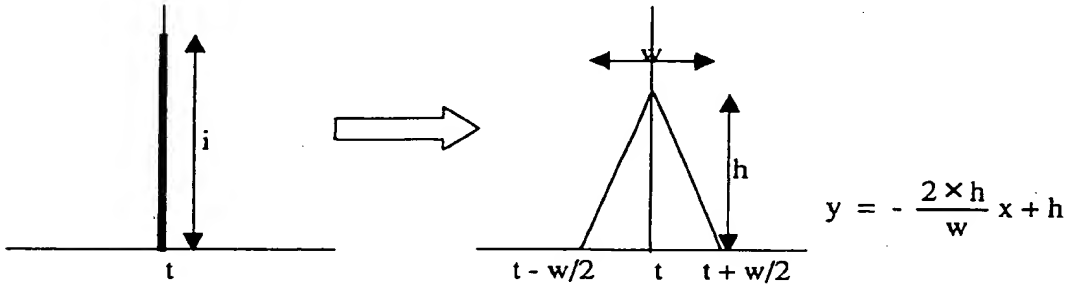


Fig. 97

図97 電流波形算出処理
ブロック図(実施形態23)

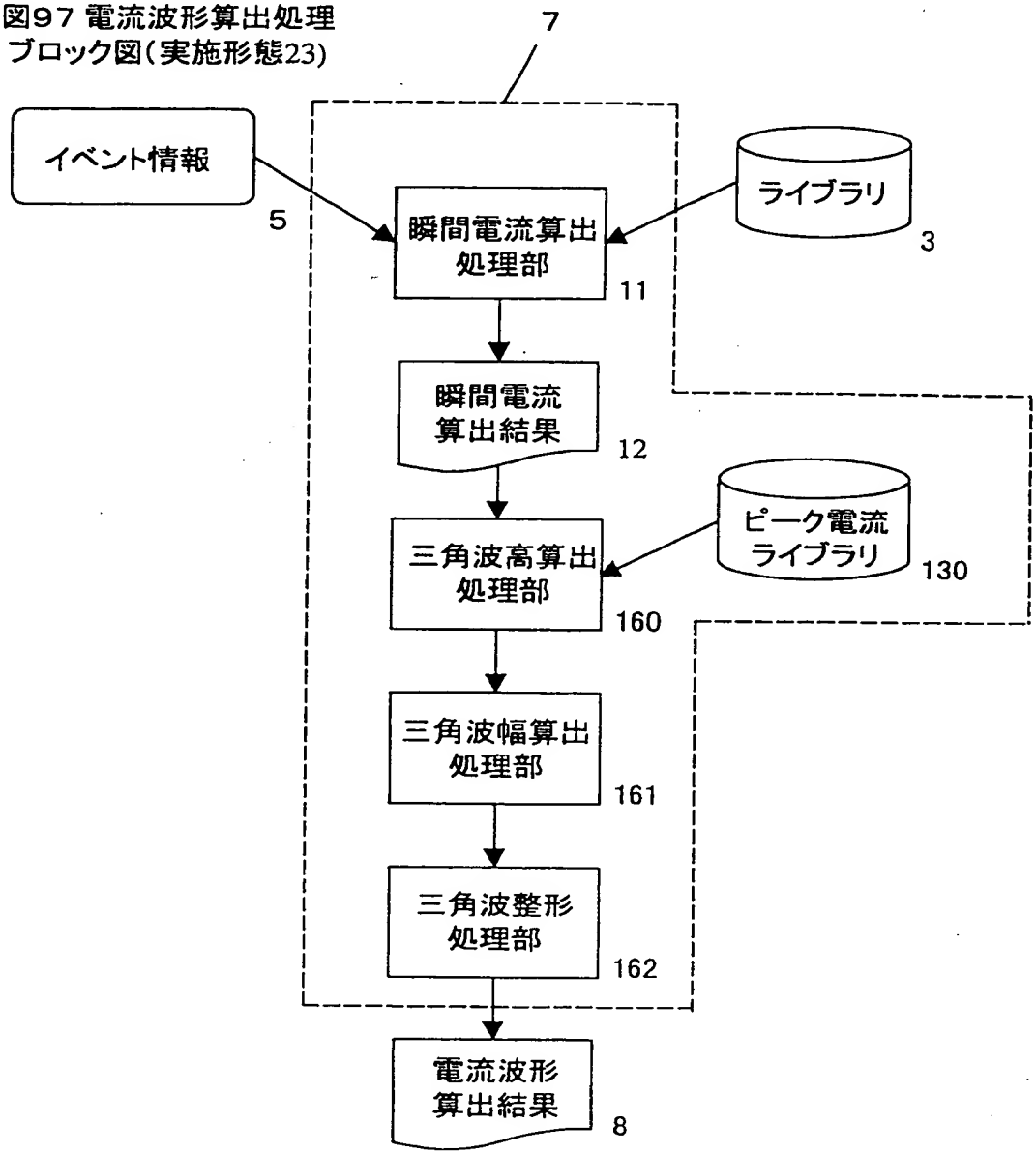


Fig. 98

図98 三角波整形処理フロー図

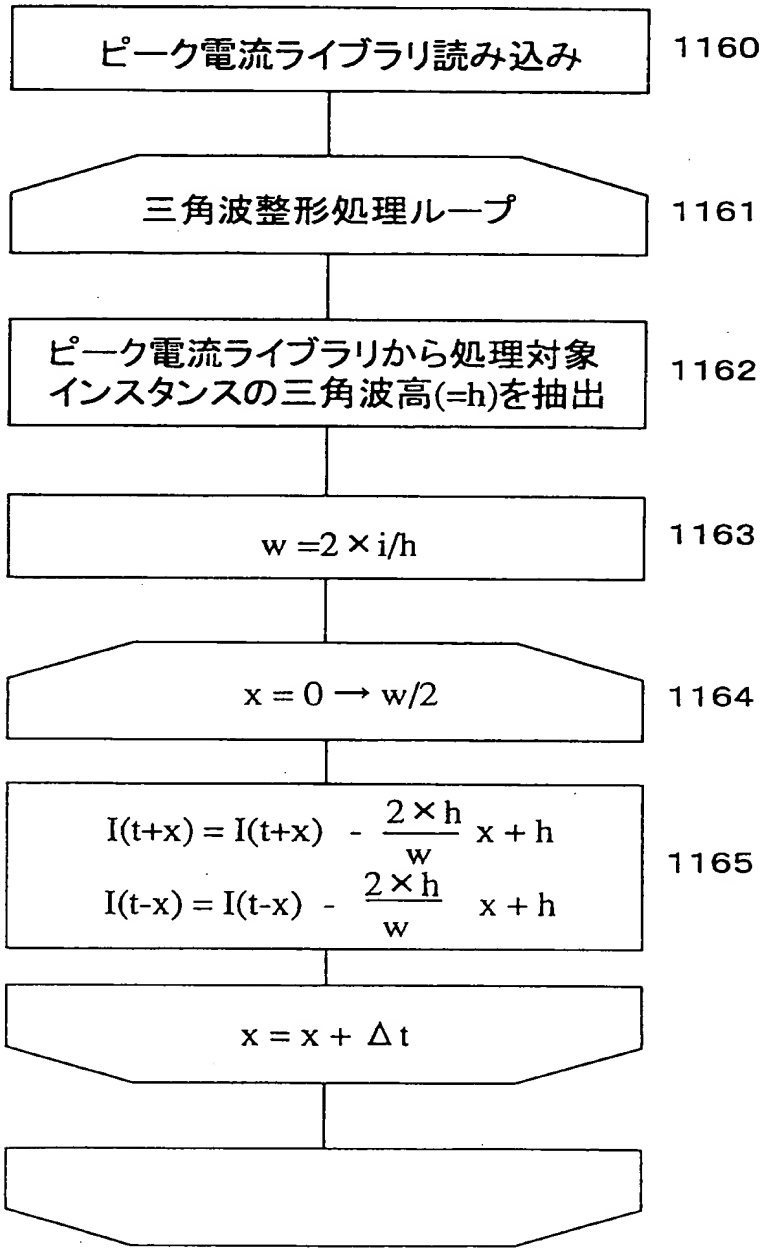
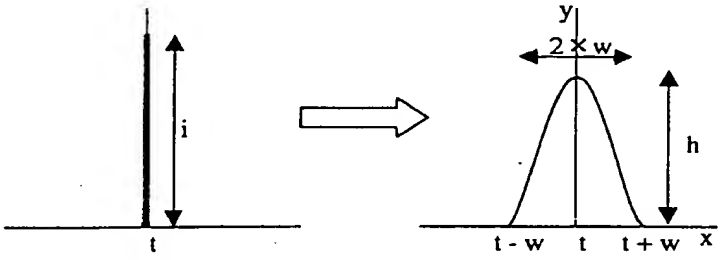


Fig.99

図99 複数次関数モデル(実施形態24)



$$y = a\,(x - w)^2 (x + w)^2$$

$$w = \frac{15 \times i}{16 \times h}$$

$$a = \frac{15}{16 \times w^5}\ i$$

Fig. 100

図100 電流波形算出処理
ブロック図(実施形態24)

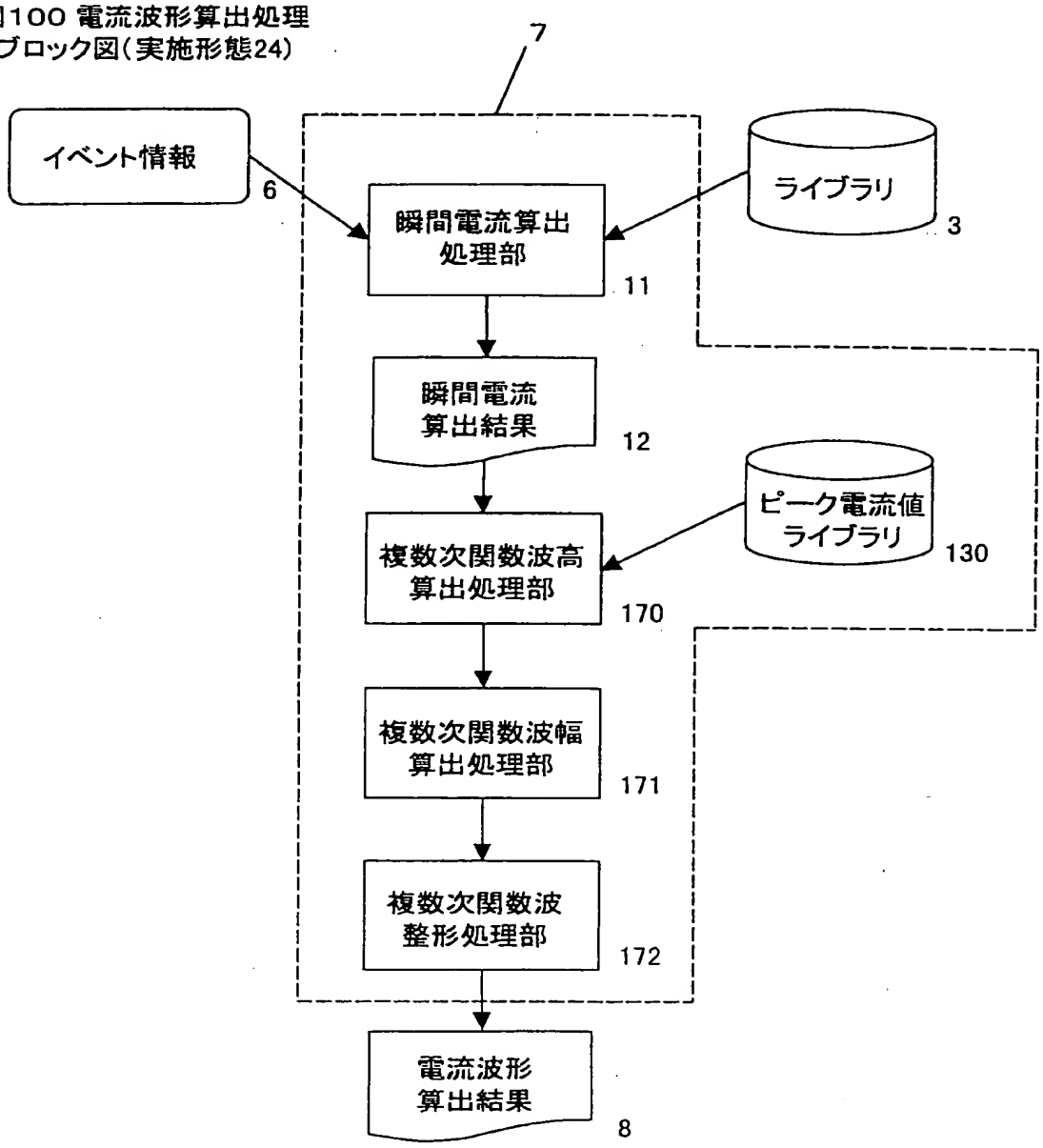


Fig.101

図101 複数次関数整形処理フロー図

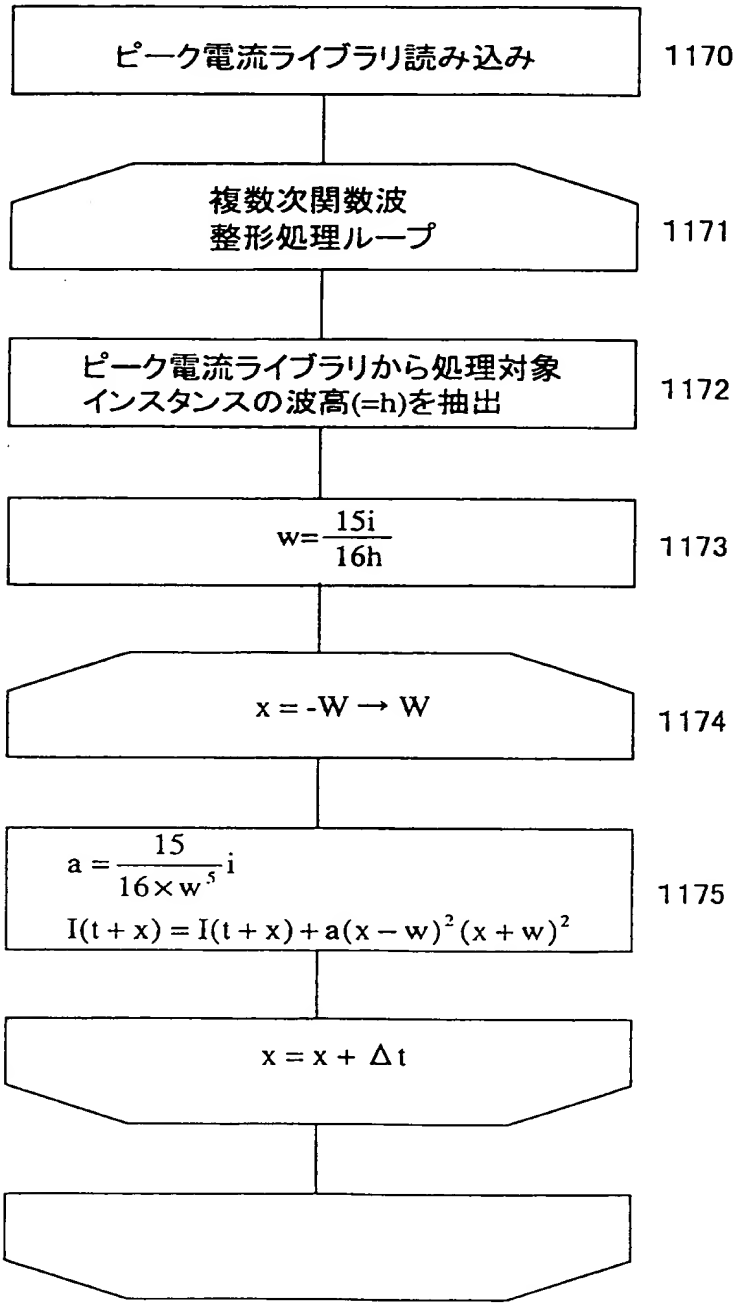


Fig. 102

図102 電流波形算出処理
ブロック図(実施形態25)

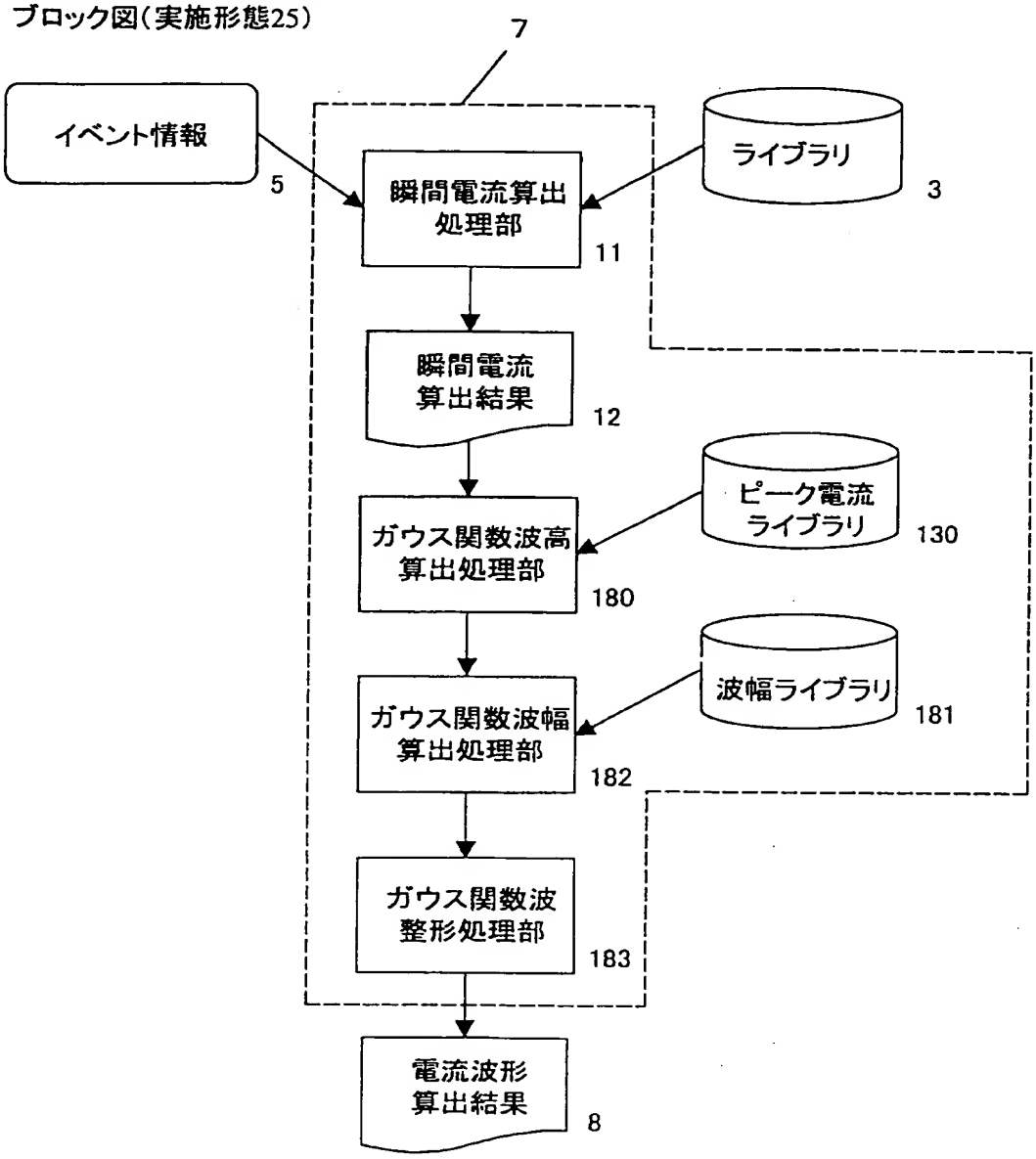


Fig. 103

図103ガウス関数波整形処理フロー図

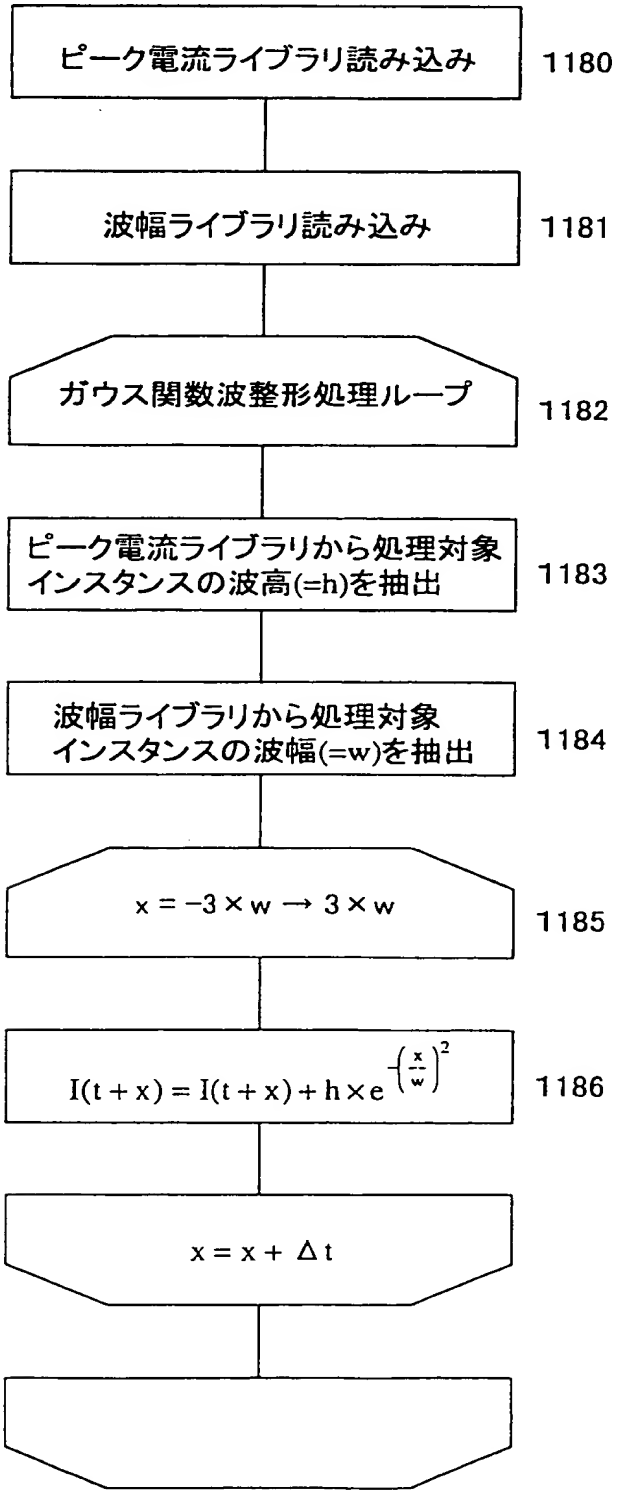


Fig. 104

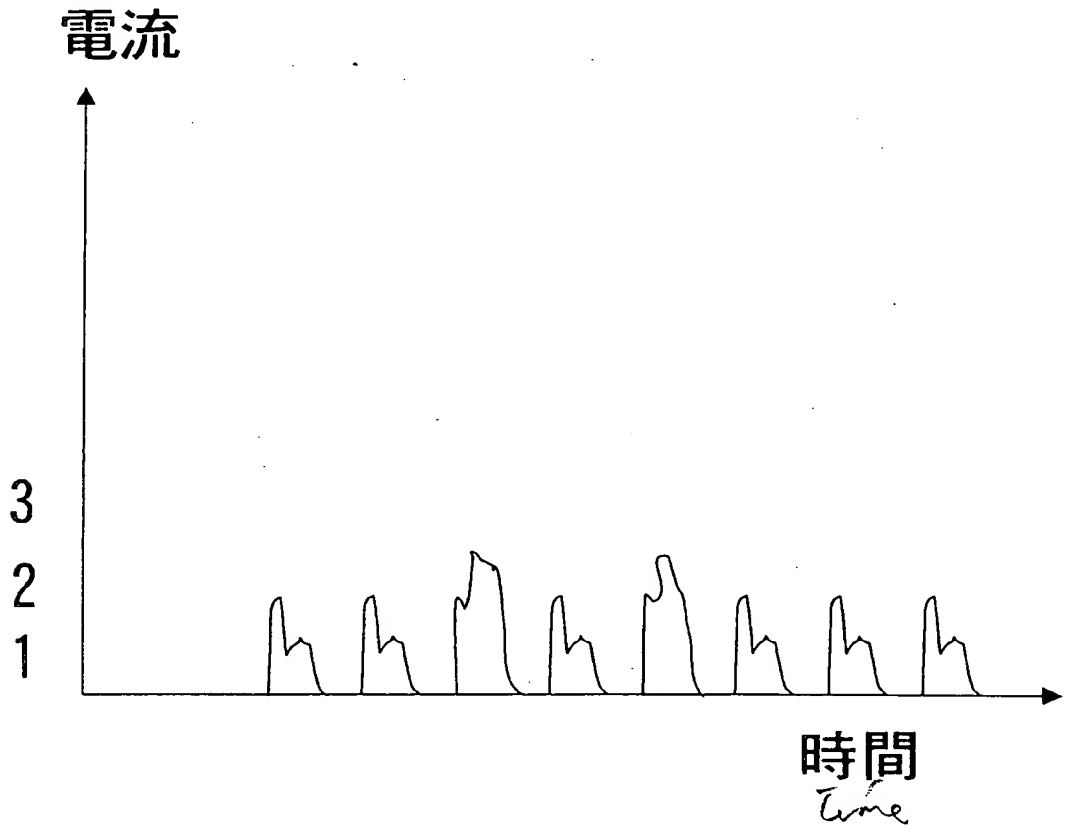


Fig.105

フリップフロップFF/Q

貫通電流総量	total	3mA
貫通電流ピーク値	peak	1mA
チャージ電流総量	total	4mA
チャージ電流ピーク値	peak	2mA

フリップフロップFF/CK

貫通電流総量	total	2mA
貫通電流ピーク値	peak	1mA
チャージ電流総量	total	0mA
チャージ電流ピーク値	peak	0mA

バッファBUF/Y

貫通電流総量	Total	2mA
貫通電流ピーク値	peak	1mA
チャージ電流総量	total	0mA
チャージ電流ピーク値	peak	0mA

Fig. 106

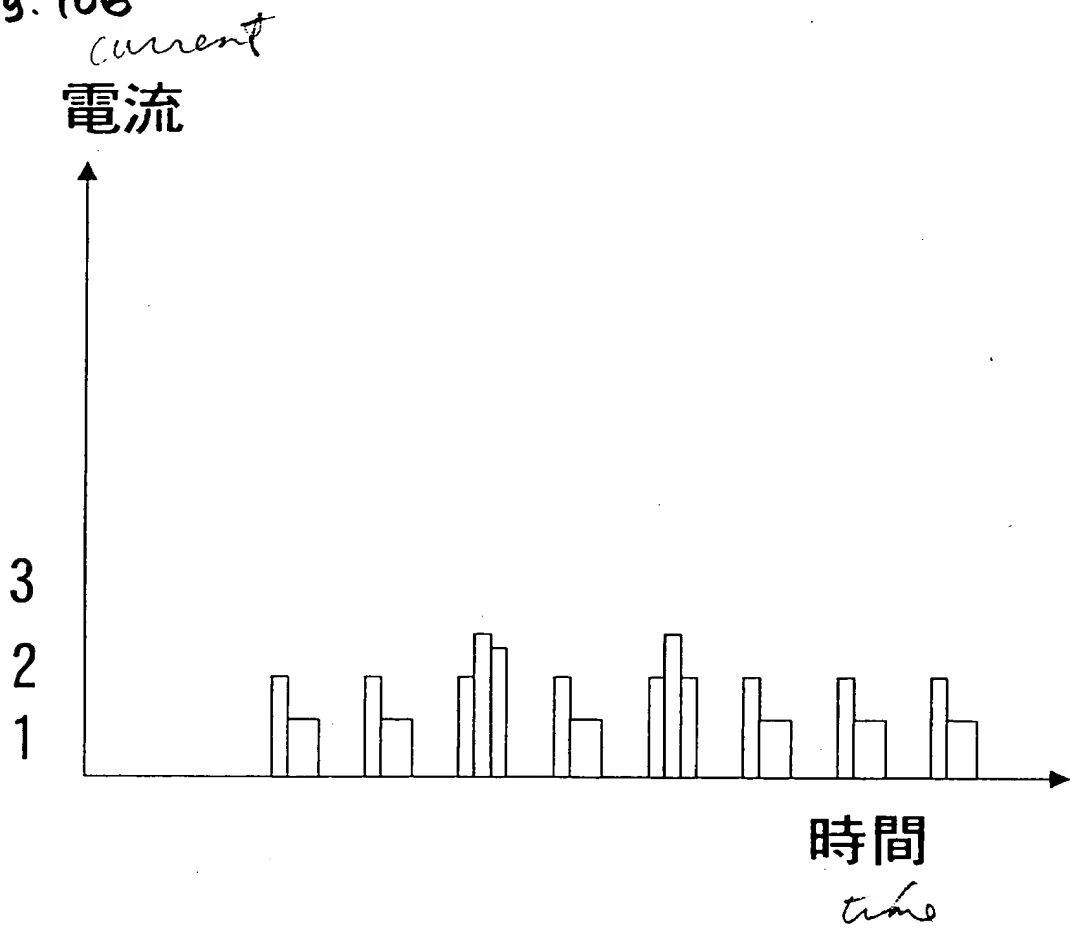


Fig.107

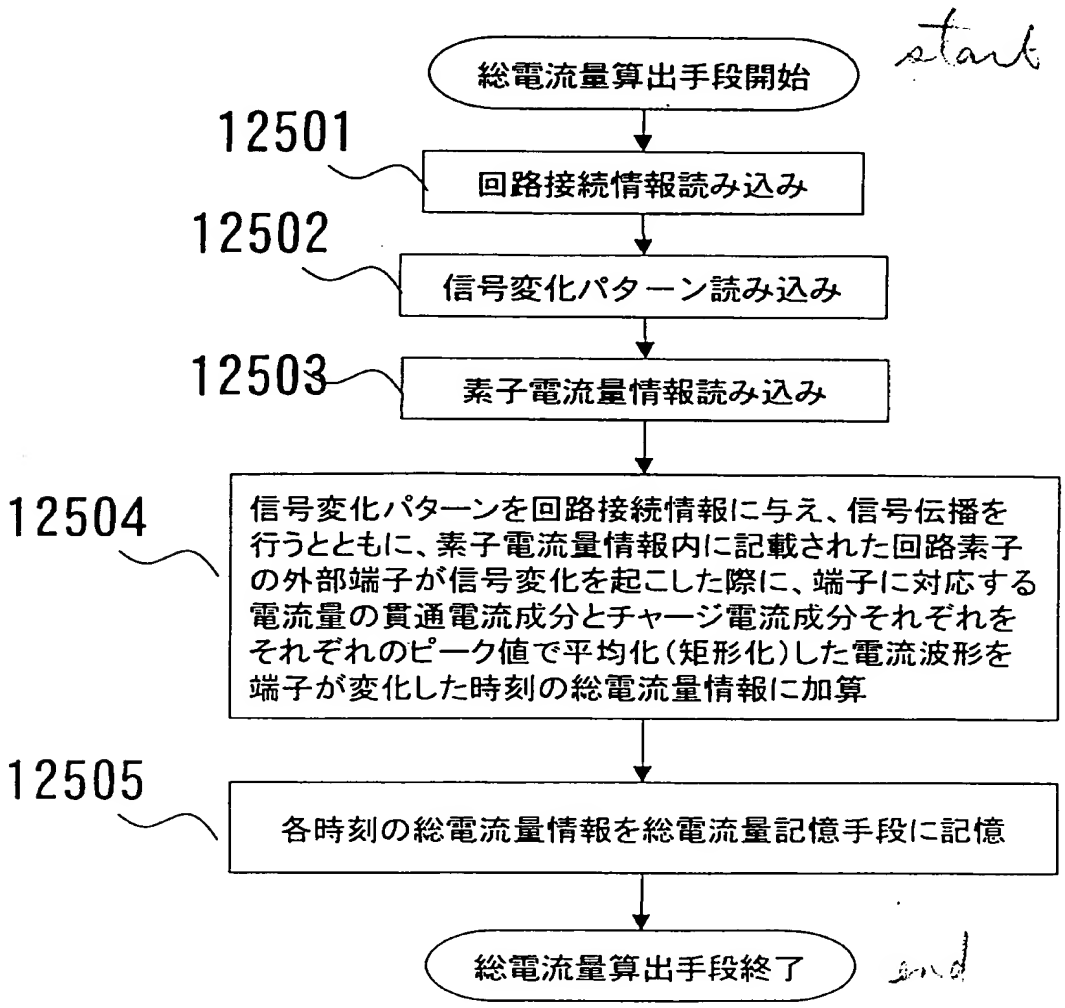


Fig. 108

NANDNOR

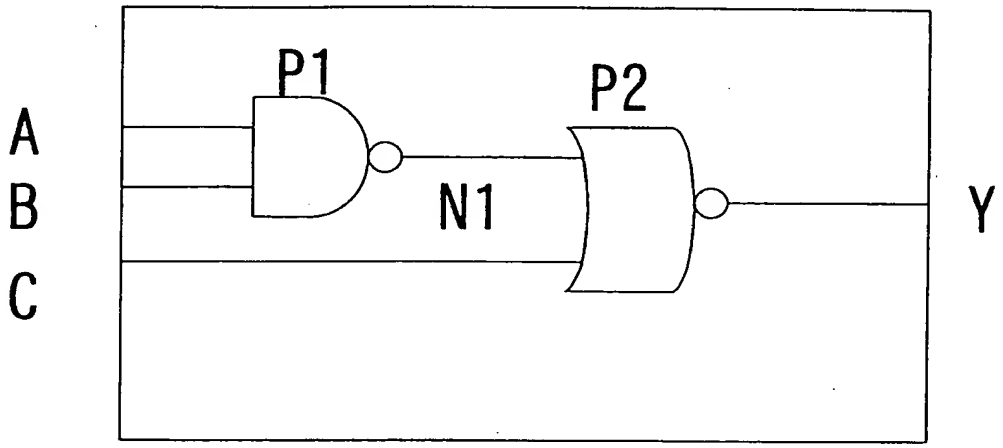


Fig. 109

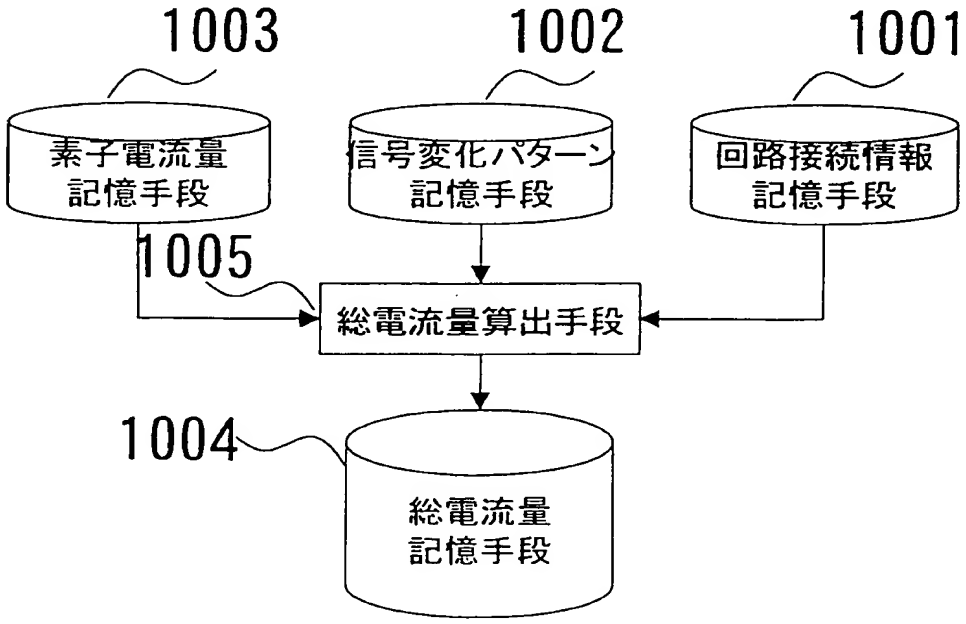


Fig.110

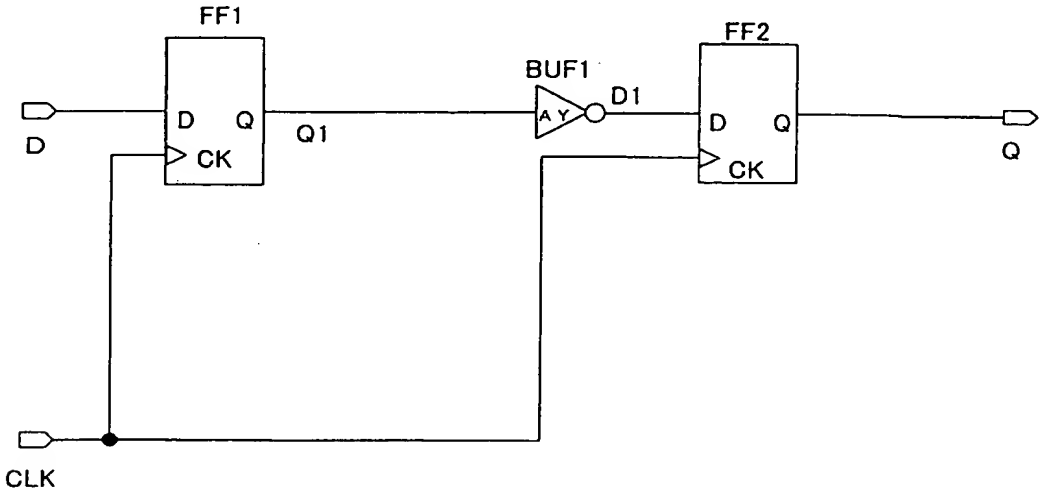


Fig.111

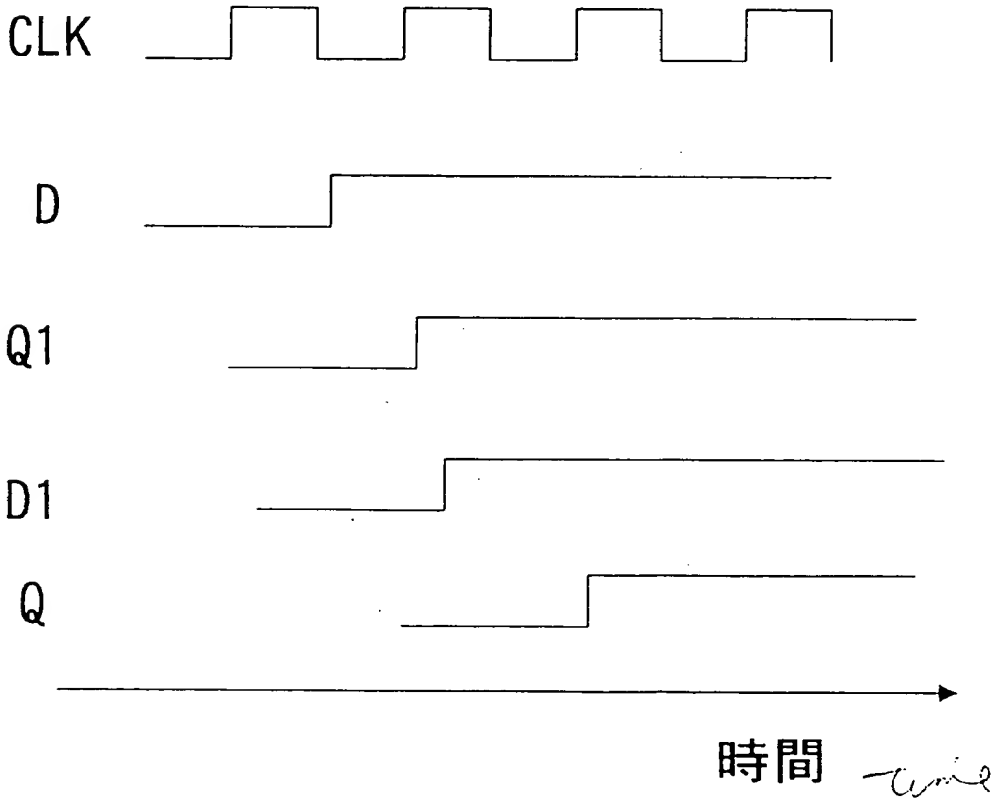


Fig.112

フリップフロップFF
Y変化時電流量　5mA　～1301
CK変化時電流量　2mA　～1302

バッファBUF
Y変化時電流量　1mA　～1303

Fig.113

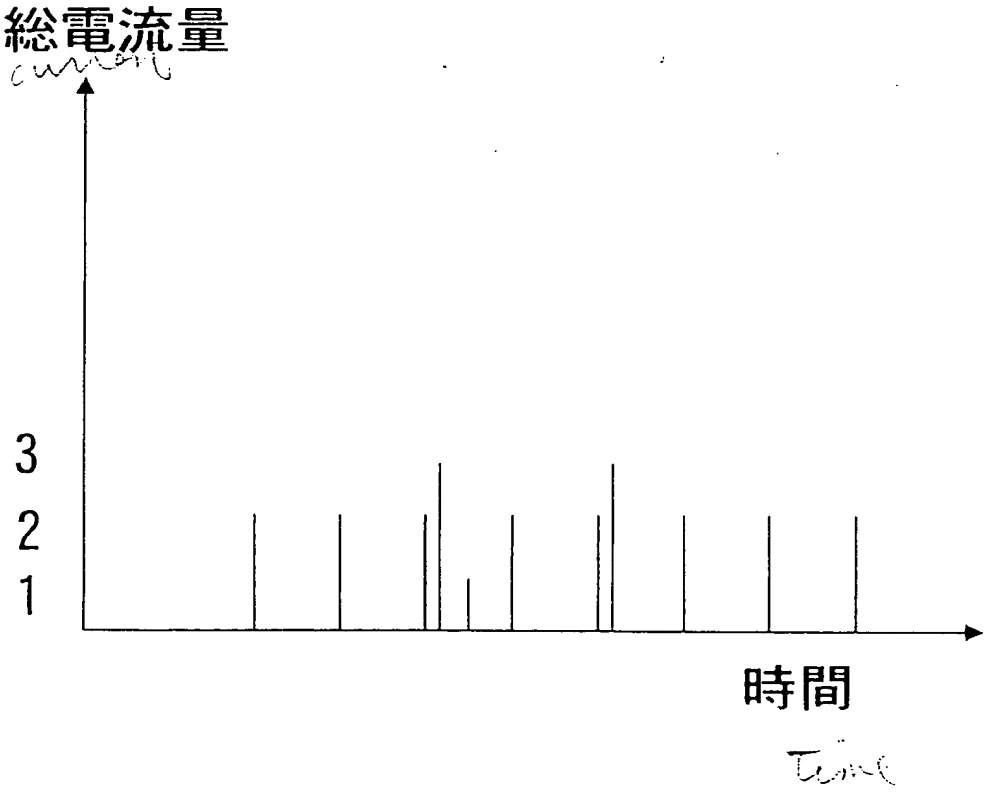


Fig. 114

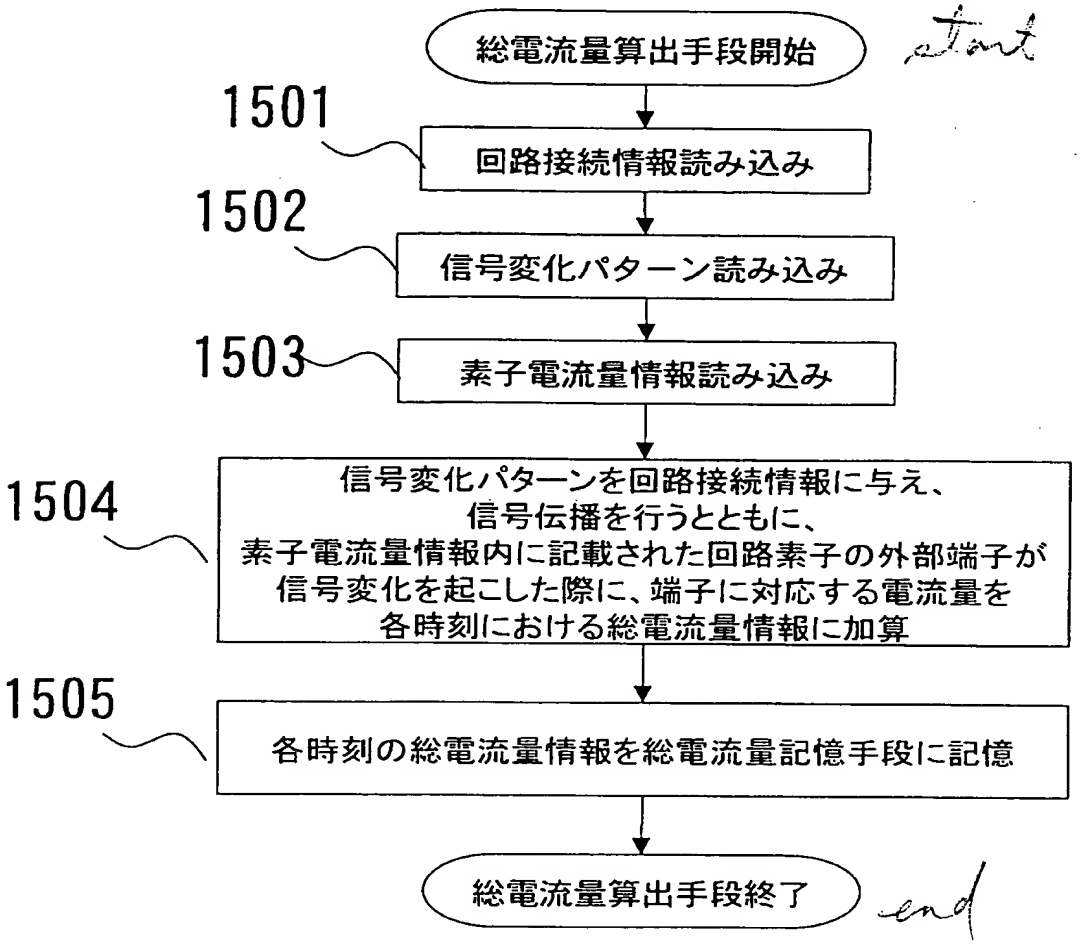


Fig. 115

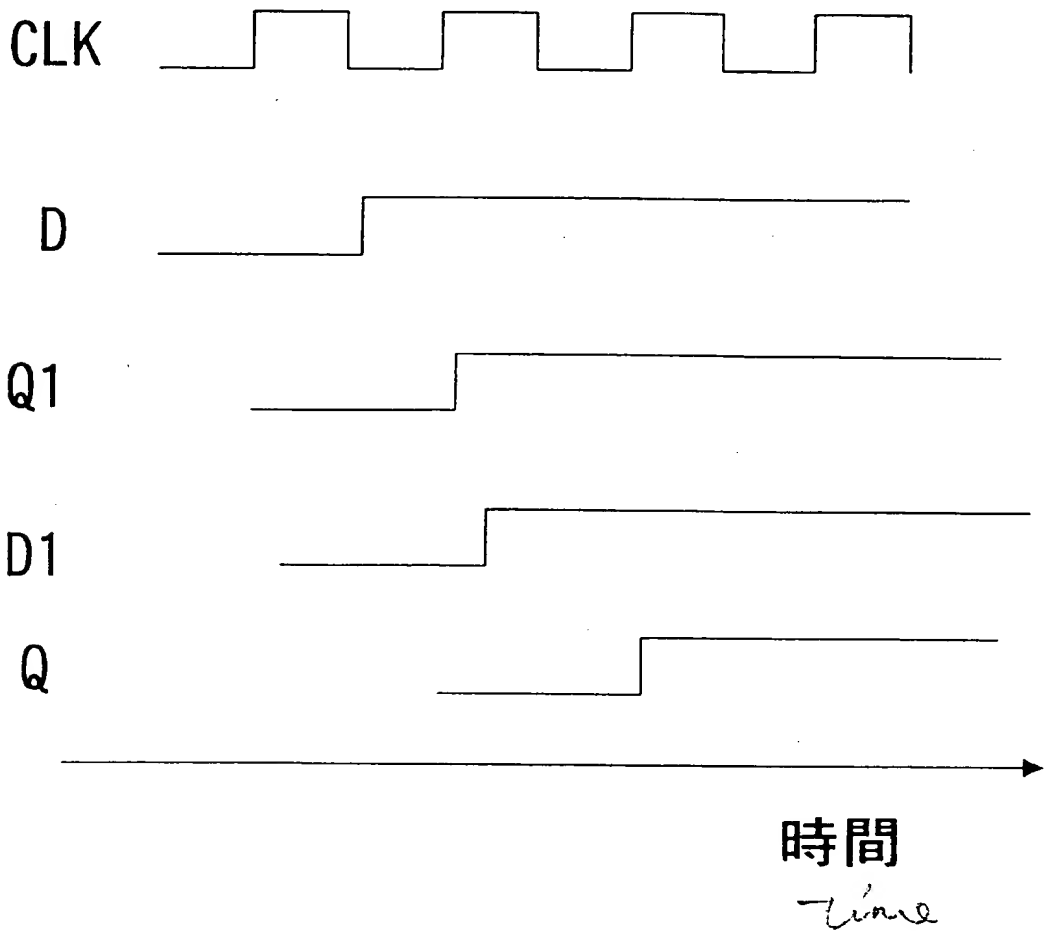


Fig.116

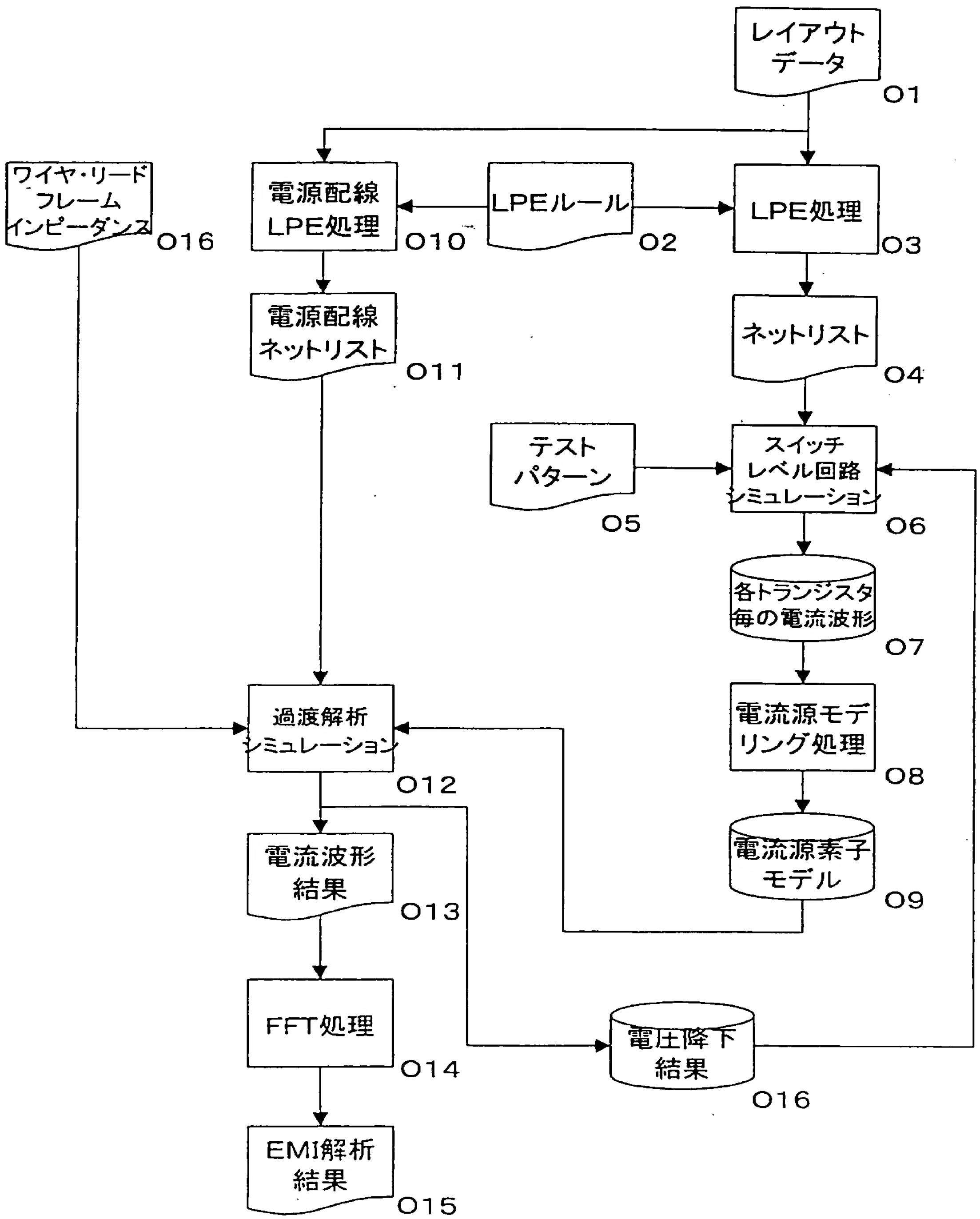


Fig.117

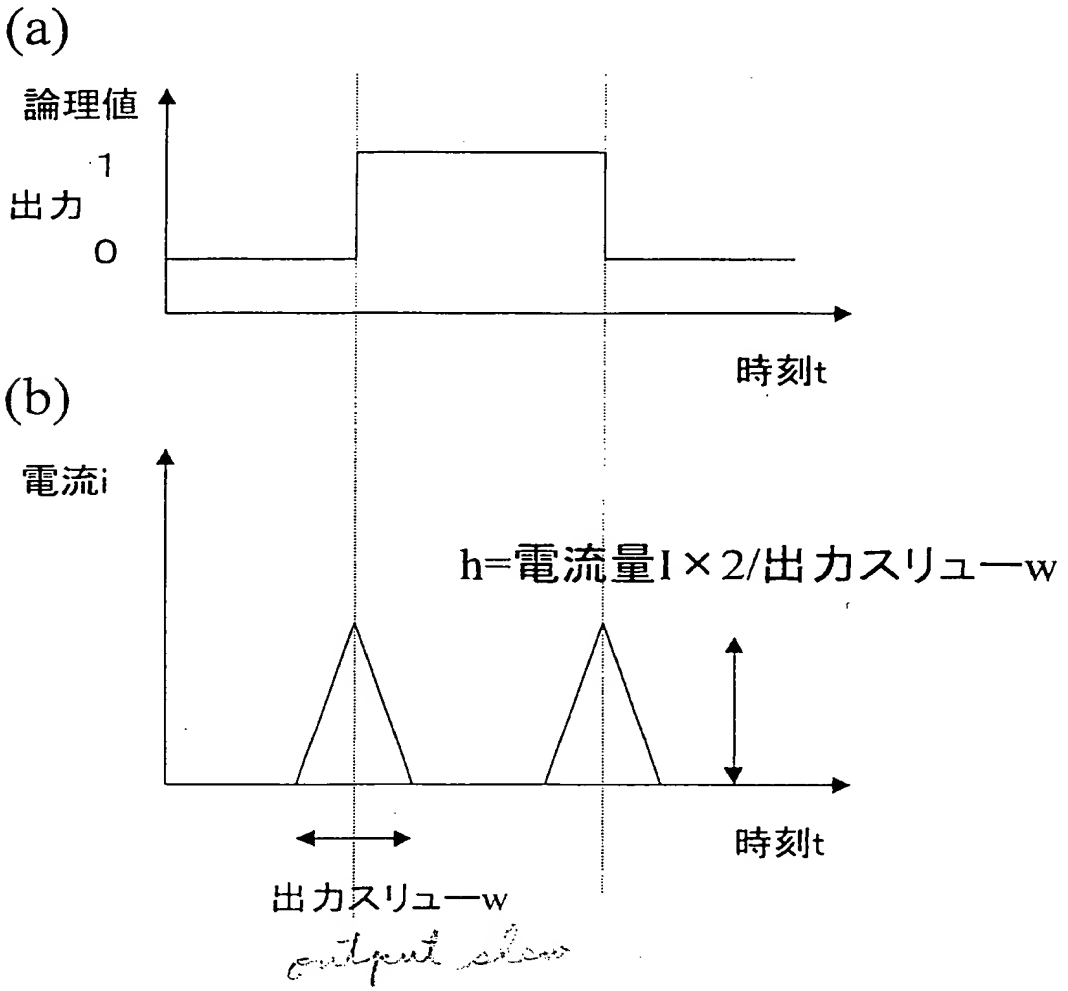


Fig. 118

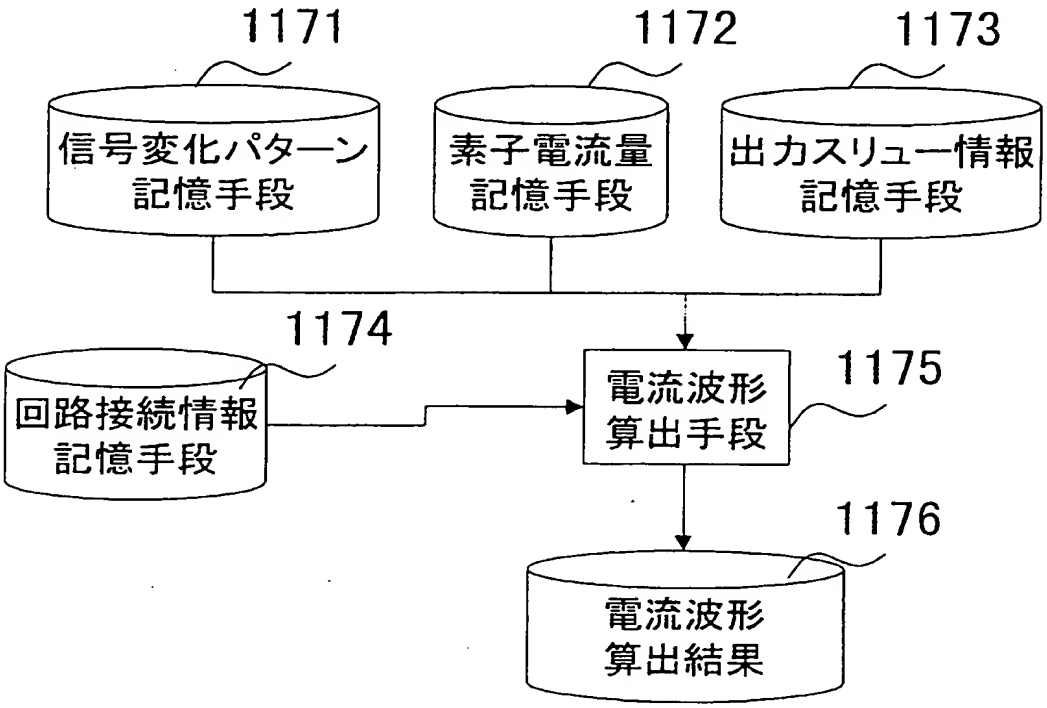


Fig. 119

電流波形算出手段処理フロー図

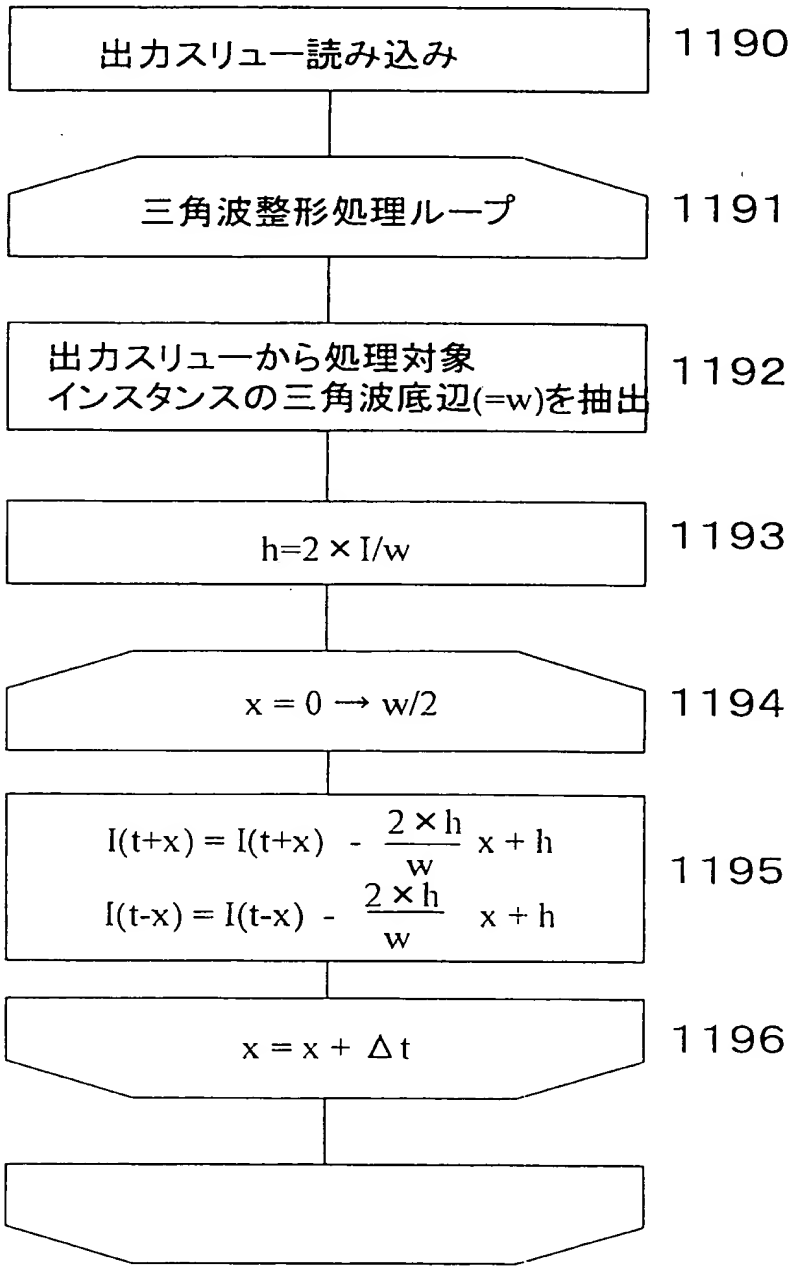
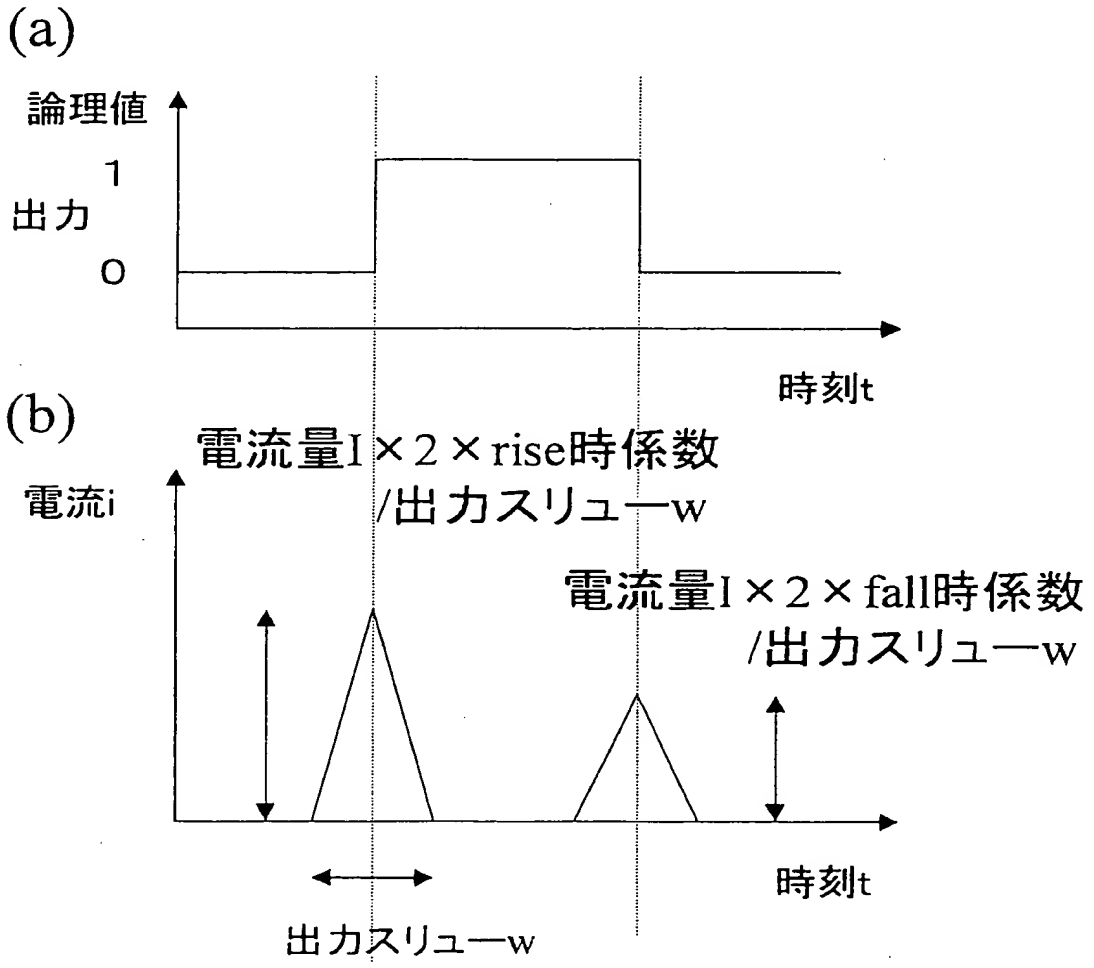


Fig.120



※fall時係数=2-rise時係数

Fig.121

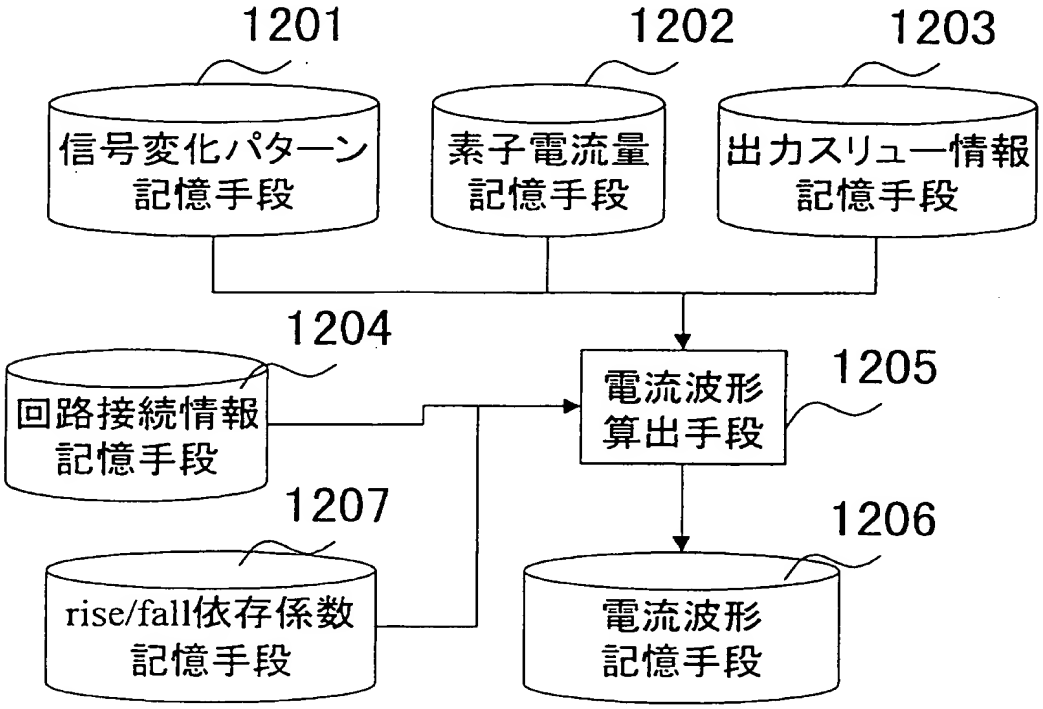
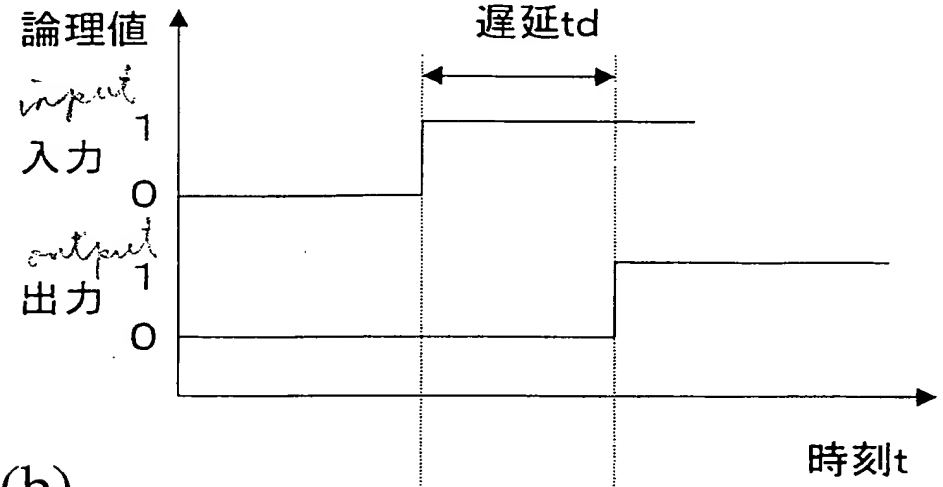


Fig. 122

(a)



(b)

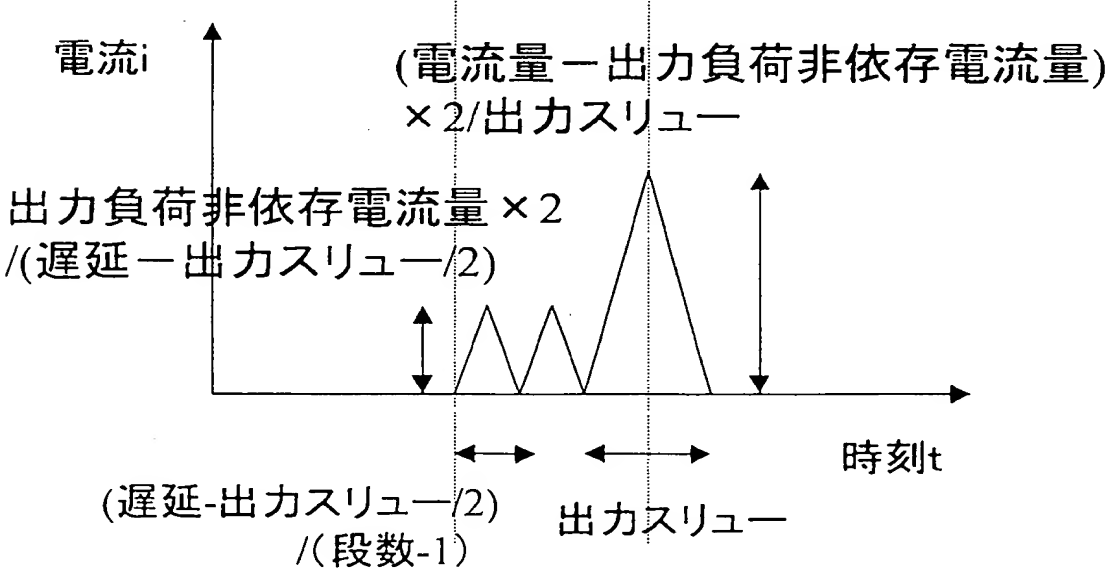
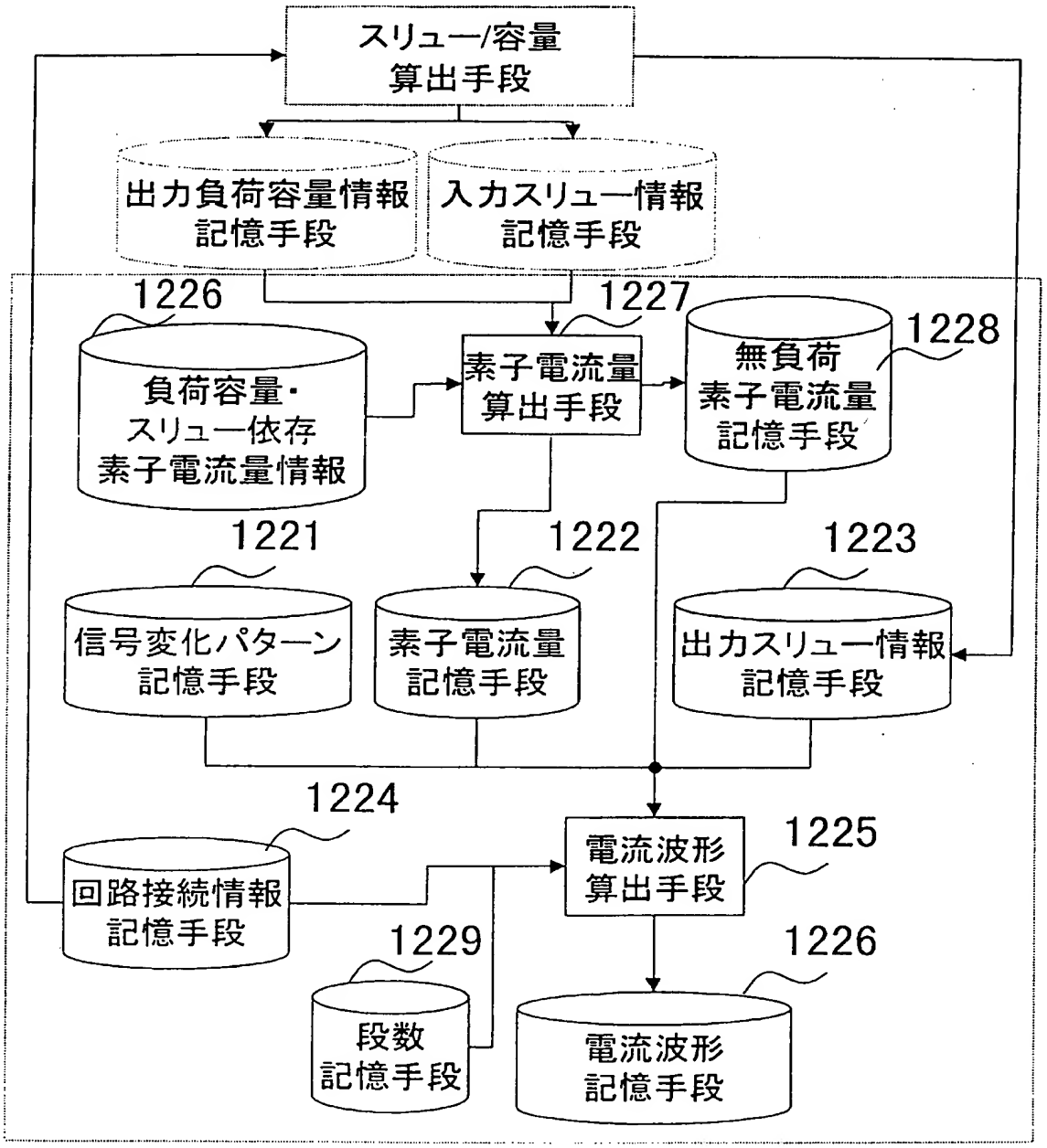


Fig.123



[Description of Reference Numerals]

1 net list

2 test vector

3 library

4 logic simulator

5 event information

6 simulation result

7 current waveform calculation section

8 current waveform calculation result

9 FFT processing section

10 result of EMI analysis

11 instantaneously-changing current calculation section

12 calculation result of instantaneously-changing current

13 current waveform averaging section

20 first rectangular waveform height calculation section

21 first rectangular waveform-shaping section

30 second rectangular waveform height calculation section

31 second rectangular waveform width calculation section

32 second rectangular waveform-shaping section

40 i-h table

41 third rectangular waveform height calculation section

42 third rectangular waveform width calculation section

43 third rectangular waveform-shaping section

50 i-s-h table

51 Slew data

52 fourth rectangular waveform height calculation section

53 fourth rectangular waveform width calculation section

54 fourth rectangular waveform-shaping section

60 i-c-h table

61 capacitance data

62 fifth rectangular waveform height calculation section

63 fifth rectangular waveform width calculation section

64 fifth rectangular waveform-shaping section

100 triangular waveform height calculation section

101 triangular waveform-shaping section

120 Gaussian function waveform height calculation section

121 i-w table

122 Gaussian function waveform width calculation section

123 Gaussian function waveform-shaping section

130 peak current library

131 sixth rectangular waveform height calculation section

132 sixth rectangular waveform width calculation section

133 sixth rectangular waveform shaping section

140 s-h table

141 seventh rectangular waveform height calculation section

142 seventh rectangular waveform width calculation section

143 seventh rectangular waveform shaping section

150 c-h table

151 eighth rectangular waveform height calculation section

152 eighth rectangular waveform width calculation section

153 eighth rectangular waveform shaping section

160 triangular waveform height calculation section

161 triangular waveform width calculation section

162 triangular waveform shaping section

170 multi-order-function waveform height calculation section

171 multi-order-function waveform width calculation section

172 multi-order-function waveform shaping section

180 Gaussian function waveform height calculation section

181 width library

182 Gaussian function waveform width calculation section

183 Gaussian function waveform shaping section

[DESIGNATION OF DOCUMENT] ABSTRACT OF THE DISCLOSURE

[ABSTRACT]

[PROBLEM] EMI analysis involving a transistor-scale simulation requires consumption of much processing time, and analysis of overall EMI arising in an LSI has been unrealistic. Further, a gate-scale logic simulation cannot correctly replicate a change in electric current. Hence, the gate-scale logic simulation cannot be used for EMI analysis.

[Means of Solution] In a gate-scale logic simulation, a change in electric current is calculated from event information 5 output from a logic simulator 4 through use of a current waveform calculation section 7. The thus-calculated change in current is subjected to FFT processing through use of an FFT processing section 9, thereby determining a frequency characteristic of EMI and enabling EMI analysis.

[Selected Drawing] FIG. 18

[DESIGNATION OF DOCUMENT]

[FIG. 1]

BLOCK DIAGRAM SHOWING OVERALL FLOW OF PROCESSING OF EMI ANALYSIS METHOD ACCORDING TO THE PRESENT INVENTION

1 NET LIST

2 TEST VECTOR

3 LIBRARY

4 LOGIC SIMULATOR

5 EVENT INFORMATION

6 SIMULATION RESULT

7 CURRENT WAVEFORM CALCULATION SECTION

8 RESULT OF CURRENT WAVEFORM CALCULATION

9 FFT PROCESSING SECTION

10 RESULT OF EMI ANALYSIS

[FIG. 2]

BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION (FIRST EMBODIMENT)

3 LIBRARY

5 EVENT INFORMATION

8 CALCULATION RESULT OF CURRENT WAVEFORM

11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION

12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT

13 CURRENT WAVEFORM AVERAGING SECTION

[FIG. 3]

CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING ELECTRIC CURRENT

AMOUNT OF CURRENT

[FIG. 4]

FLOWCHART FOR AVERAGING CURRENT WAVEFORM

STEP S1010 AVERAGING LOOP

[FIG. 5]

CALCULATION RESULT OF CURRENT WAVEFORM (FIRST EMBODIMENT)

AT T=5

[FIG. 6]
RESULT OF FFT ANALYSIS
INTENSITY
FREQUENCY

[FIG. 7]
RECTANGULAR WAVEFORM MODEL (SECOND EMBODIMENT)
W IS CONSTANT

[FIG. 8]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION (SECOND EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
20 FIRST RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
21 FIRST RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 9]
FLOWCHART OF FIRST RECTANGULAR WAVEFORM SHAPING OPERATION
1020 RECTANGULAR WAVEFORM SHAPING LOOP

[FIG. 10]
CALCULATION RESULT OF CURRENT WAVEFORM (SECOND EMBODIMENT)
AT W = 5

[FIG. 11]
RECTANGULAR WAVEFORM MODEL (THIRD EMBODIMENT)
h/w = K = CONSTANT

[FIG. 12]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION

(THIRD EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
30 SECOND RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
31 SECOND RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
32 SECOND RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 13]
FLOWCHART OF SECOND RECTANGULAR WAVEFORM SHAPING OPERATION
1030 RECTANGULAR WAVEFORM SHAPING LOOP

[FIG. 14]
CALCULATION RESULT OF CURRENT WAVEFORM (THIRD EMBODIMENT)
AT K=4

[FIG. 15]
RECTANGULAR WAVEFORM MODEL (FOURTH, FIFTH, AND SIXTH
EMBODIMENTS)

[FIG. 16]
i-h TABLE
IN THE CASE OF i=70

[FIG. 17]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION
(FOURTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
40 i-h TABLE
41 THIRD RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION

42 THIRD RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
43 THIRD RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 18]
FLOWCHART OF THIRD RECTANGULAR WAVEFORM SHAPING OPERATION
1040 READ i-h TABLE
1041 RECTANGULAR WAVEFORM SHAPING LOOP
1042 EXTRACT (i1, h1) (i2, h2)

[FIG. 19]
CALCULATION RESULT OF CURRENT WAVEFORM (FOURTH EMBODIMENT)

[FIG. 20]
i-s-h TABLE
IN THE CASE OF i=70, s=1

[FIG. 21]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION
(FIFTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
50 i-s-h TABLE
51 SLEW DATA
52 FOURTH RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
53 FOURTH RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
54 FOURTH RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 22]
FLOWCHART OF FOURTH RECTANGULAR WAVEFORM SHAPING OPERATION
1050 READ i-s-h TABLE
1051 READ SLEW DATA
1052 RECTANGULAR WAVEFORM SHAPING LOOP
1053 EXTRACT (s1, i1), (s1, i2), (s2, i1), (s2, i2)

[FIG. 23]
CALCULATION RESULT OF CURRENT WAVEFORM (FIFTH EMBODIMENT) IN THE CASE OF i=70, C=10

[FIG. 24]
i-c-h TABLE

[FIG. 25]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION (SIXTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
60 i-c-h TABLE
61 CAPACITANCE DATA
62 FIFTH RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
63 FIFTH RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
64 FIFTH RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 26]
FLOWCHART OF FIFTH RECTANGULAR WAVEFORM SHAPING OPERATION
1060 READ i-c-h TABLE
1061 READ CAPACITANCE DATA
1062 RECTANGULAR WAVEFORM SHAPING LOOP
1063 EXTRACT

[FIG. 27]
CALCULATION RESULT OF CURRENT WAVEFORM (SIXTH EMBODIMENT)

[FIG. 28]
1 NET LIST
2 TEST VECTOR
3 LIBRARY

4 LOGIC SIMULATOR
5 EVENT INFORMATION
6 SIMULATION RESULT
8 CALCULATION RESULT OF CURRENT WAVEFORM
9 FFT PROCESSING SECTION
10 RESULT OF EMI ANALYSIS
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
13 CURRENT WAVEFORM AVERAGING SECTION
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE
A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION
A11 LINE VOLTAGE DROP CALCULATION/INSTANTANEOUSLY-CHANGING CURRENT CORRECTION SECTION

[FIG. 29]
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE
A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION
B1 INFORMATION CONCERNING INSTANTANEOUSLY-CHANGING CURRENT FOR EACH INSTANCE
B2 EXTRACTION OF POWER NET
B3 CALCULATION OF CURRENT FLOWING IN EACH SEGMENT
B4 INFORMATION CONCERNING EACH SEGMENT IN POWER LINE
B5 INFORMATION CONCERNING CURRENT PER EACH SEGMENT
B6 CALCULATION OF RESISTANCE OF EACH SEGMENT
B7 CALCULATION OF VOLTAGE DROP IN EACH SEGMENT
B8 INFORMATION CONCERNING RESISTANCE OF EACH SEGMENT
B9 INFORMATION CONCERNING VOLTAGE DROP IN EACH SEGMENT
B10 CALCULATION OF VOLTAGE DROP OF EACH INSTANCE
B11 INFORMATION CONCERNING VOLTAGE DROP IN EACH INSTANCE
B12 CORRECTION OF ELECTRIC CURRENT

[FIG. 30]
INSTANCE 1, INSTANCE 2, INSTANCE 3

[FIG. 31]
INSTANCE 1, INSTANCE 2, INSTANCE 3

[FIG. 32]
INSTANCE 1, INSTANCE 2, INSTANCE 3

[FIG. 33]
INSTANCE 1, INSTANCE 2, INSTANCE 3

[FIG. 34]
INSTANCE 1, INSTANCE 2, INSTANCE 3

[FIG. 35]
INSTANCE 1, INSTANCE 2, INSTANCE 3
VOLTAGE DROP IN INSTANCE 1
VOLTAGE DROP IN INSTANCE 2
VOLTAGE DROP IN INSTANCE 3

[FIG. 36]
1 NET LIST
2 TEST VECTOR
3 LIBRARY
4 LOGIC SIMULATOR
5 EVENT INFORMATION
6 SIMULATION RESULT
8 CALCULATION RESULT OF CURRENT WAVEFORM
9 FFT PROCESSING SECTION
10 RESULT OF EMI ANALYSIS
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
13 CURRENT WAVEFORM AVERAGING SECTION
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE

A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION
C1 C-V TABLE OR C-V FUNCTION
C2 LINE VOLTAGE DROP CALCULATION/INSTANTANEOUSLY-CHANGING CURRENT CORRECTION SECTION

[FIG. 37]
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE
A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION
C1 C-V TABLE OR C-V FUNCTION
B1 INFORMATION CONCERNING INSTANTANEOUSLY-CHANGING CURRENT FOR EACH INSTANCE
B2 EXTRACTION OF POWER NET
B3 CALCULATION OF CURRENT FLOWING IN EACH SEGMENT
B4 INFORMATION CONCERNING EACH SEGMENT IN POWER LINE
B5 INFORMATION CONCERNING CURRENT PER EACH SEGMENT
B6 CALCULATION OF RESISTANCE OF EACH SEGMENT
B8 INFORMATION CONCERNING RESISTANCE OF EACH SEGMENT
B9 INFORMATION CONCERNING VOLTAGE DROP IN EACH SEGMENT
B10 CALCULATION OF VOLTAGE DROP OF EACH INSTANCE
B11 INFORMATION CONCERNING VOLTAGE DROP IN EACH INSTANCE
B12 CORRECTION OF ELECTRIC CURRENT
D1 CALCULATION OF CAPACITANCE PROVIDED BETWEEN SEGMENTS
D2 INFORMATION CONCERNING CAPACITANCE PROVIDED BETWEEN SEGMENTS
D3 CALCULATION OF VOLTAGE DROP IN EACH SEGMENT

[FIG. 38]
INSTANCE 1, INSTANCE 2, INSTANCE 3

[FIG. 39]
INSTANCE 1, INSTANCE 2, INSTANCE 3
VOLTAGE DROP IN INSTANCE 1

VOLTAGE DROP IN INSTANCE 2
VOLTAGE DROP IN INSTANCE 3

[FIG. 40]
1 NET LIST
2 TEST VECTOR
3 LIBRARY
4 LOGIC SIMULATOR
5 EVENT INFORMATION
6 SIMULATION RESULT
8 CALCULATION RESULT OF CURRENT WAVEFORM
9 FFT PROCESSING SECTION
10 RESULT OF EMI ANALYSIS
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
13 CURRENT WAVEFORM AVERAGING SECTION
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE
A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION
E1 LINE VOLTAGE DROP CALCULATION/INSTANTANEOUSLY-CHANGING CURRENT CORRECTION SECTION

[FIG. 41]
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE
A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION
B1 INFORMATION CONCERNING INSTANTANEOUSLY-CHANGING CURRENT FOR EACH INSTANCE
B2 EXTRACTION OF POWER NET
B4 INFORMATION CONCERNING EACH SEGMENT IN POWER LINE
B6 CALCULATION OF RESISTANCE OF EACH SEGMENT
B8 INFORMATION CONCERNING RESISTANCE OF EACH SEGMENT
B11 INFORMATION CONCERNING VOLTAGE DROP IN EACH INSTANCE

B12 CORRECTION OF ELECTRIC CURRENT
D1 CALCULATION OF CAPACITANCE PROVIDED BETWEEN SEGMENTS
D2 INFORMATION CONCERNING CAPACITANCE PROVIDED BETWEEN SEGMENTS
F1 TRANSIENT ANALYSIS

[FIG. 42]
TRIANGULAR WAVEFORM MODEL (TENTH EMBODIMENT)
W IS CONSTANT

[FIG. 43]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION (TENTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
100 TRIANGULAR WAVEFORM HEIGHT CALCULATION SECTION
101 TRIANGULAR WAVEFORM SHAPING SECTION

[FIG. 44]
FLOWCHART OF FIFTH TRIANGULAR WAVEFORM SHAPING OPERATION
1100 TRIANGULAR WAVEFORM SHAPING LOOP

[FIG. 45]
CALCULATION RESULT OF CURRENT WAVEFORM (TENTH EMBODIMENT) AT W=5

[FIG. 46]
MULTI-ORDER-FUNCTION MODEL (ELEVENTH EMBODIMENT)
W IS CONSTANT
IN THE CASE OF W=2.5, i=100
IN THE CASE OF W=2.5, i=50

[FIG. 47]

BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION (ELEVENTH EMBODIMENT)

3 LIBRARY

5 EVENT INFORMATION

8 CALCULATION RESULT OF CURRENT WAVEFORM

11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION

12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT

110 MULTI-ORDER-FUNCTION WAVEFORM HEIGHT CALCULATION SECTION

111 MULTI-ORDER-FUNCTION WAVEFORM SHAPING SECTION

[FIG. 48]

FLOWCHART OF MULTI-ORDER-FUNCTION WAVEFORM SHAPING OPERATION

1110 MULTI-ORDER-FUNCTION WAVEFORM SHAPING LOOP

[FIG. 49]

CALCULATION RESULT OF CURRENT WAVEFORM (ELEVENTH EMBODIMENT) AT W=2.5

[FIG. 50]

GAUSSIAN FUNCTION MODEL (TWELFTH AND TWENTY-FIFTH EMBODIMENTS)

[FIG. 51]

i-h TABLE

IN THE CASE OF i=50, 100

[FIG. 52]

i-w TABLE

IN THE CASE OF i=50, 100

[FIG. 53]

BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION (TWELFTH EMBODIMENT)

3 LIBRARY

5 EVENT INFORMATION

8 CALCULATION RESULT OF CURRENT WAVEFORM

11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION

12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
40 i-h TABLE
121 i-w TABLE
120 GAUSSIAN FUNCTION WAVEFORM HEIGHT CALCULATION SECTION
122 GAUSSIAN FUNCTION WAVEFORM WIDTH CALCULATION SECTION
123 GAUSSIAN FUNCTION WAVEFORM SHAPING SECTION

[FIG. 54]
FLOWCHART OF GAUSSIAN FUNCTION WAVEFORM SHAPING
1120 READ i-h TABLE
1121 READ i-w TABLE
1122 PERFORM GAUSSIAN FUNCTION WAVEFORM SHAPING LOOP
1123 EXTRACT
1125 EXTRACT

[FIG. 55]
CALCULATION RESULT OF CURRENT WAVEFORM (TWELFTH EMBODIMENT)

[FIG. 56]
7301 CIRCUIT CONNECTION INFORMATION STORAGE MEANS
7302 PATTERN-OF-SIGNAL-CHANGE STORAGE MEANS
7303 ELEMENT CURRENT STORAGE MEANS
7304 TOTAL CURRENT STORAGE MEANS
7605 TOTAL CURRENT CALCULATION MEANS
7306 MEANS FOR STORING BASIC INFORMATION FOR ESTIMATING ELECTRIC CURRENT

[FIG. 57]
FLIP-FLIP FF
THE AMOUNT OF SHORT CIRCUIT CURRENT FLOWING WHEN Y IS CHANGED
THE AMOUNT OF CHARGE CURRENT FLOWING WHEN Y IS CHANGED
THE AMOUNT OF SHORT CIRCUIT CURRENT FLOWING WHEN CK IS CHANGED
THE AMOUNT OF CHARGE CURRENT FLOWING WHEN CK IS CHANGED

BUFFER BUF
THE AMOUNT OF SHORT CIRCUIT CURRENT FLOWING WHEN Y IS CHANGED

THE AMOUNT OF CHARGE CURRENT FLOWING WHEN Y IS CHANGED

[FIG. 58]
CURRENT
TIME

[FIG. 59]
7601 DISCRETE WIDTH USED FOR AVERAGING SHORT CIRCUIT CURRENT COMPONENT
7602 DISCRETE WIDTH USED FOR AVERAGING CHARGE CURRENT COMPONENT

[FIG. 60]
START ACTIVATION OF TOTAL CURRENT CALCULATION MEANS
7701 READ CIRCUIT CONNECTION INFORMATION
7702 READ PATTERN OF SIGNAL CHANGE
7703 READ INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING IN ELEMENT
7704 READ BASIC INFORMATION FOR ESTIMATING ELECTRIC CURRENT
7705 IMPART A PATTER OF SIGNAL CHANGE TO CIRCUIT CONNECTION INFORMATION, TO THEREBY ENABLE PROPAGATION OF A SIGNAL. IN A CASE WHERE A CHANGE HAS ARISEN IN A SIGNAL APPEARING AT AN EXTERNAL INPUT TERMINAL OF A CIRCUIT ELEMENT, THE ELEMENT BEING DESCRIBED IN THE INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH AN ELEMENT, ADD A SHORT CIRCUIT CURRENT COMPONENT AND A CHARGE CURRENT COMPONENT INCLUDED IN THE ELECTRIC CURRENT FLOWING IN THE EXTERNAL TERMINAL, AT RESPECTIVE POINTS IN TIME, TO THE SHORT CIRCUIT CURRENT COMPONENT AND THE CHARGE CURRENT COMPONENT INCLUDED IN THE INFORMATION CONCERNING THE TOTAL AMOUNT OF ELECTRIC CURRENT, RESPECTIVELY.
7706 AVERAGE SHORT CIRCUIT CURRENT COMPONENT INCLUDED IN TOTAL CURRENT INFORMATION BY DISCRETE WIDTH THEREOF, AND AVERAGE CHARGE CURRENT COMPONENT INCLUDED IN THE SAME BY DISCRETE WIDTH THEREOF, ADD AVERAGING RESULTS TOGETHER AS TOTAL AMOUNT OF CURRENT AT RESPECTIVE TIME
7707 STORE THE TOTAL AMOUNT OF CURRENT INTO TOTAL CURRENT

STORAGE MEANS
END OF OPERATION OF TOTAL CURRENT STORAGE MEANS

[FIG. 61]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION
(FOURTEENTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
130 PEAK CURRENT LIBRARY
131 SIXTH RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
132 SIXTH RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
133 SIXTH RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 62]
FLOWCHART OF SIXTH RECTANGULAR WAVEFORM SHAPING
1130 READ PEAK CURRENT LIBRARY
1131 PERFORM RECTANGULAR WAVEFORM SHAPING LOOP
1132 EXTRACT HEIGHT OF RECTANGULAR WAVEFORM OF OBJECT INSTANCE
FROM PEAK CURRENT LIBRARY

[FIG. 63]
s-h TABLE
IN THE CASE OF s=1.2

[FIG. 64]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION
(FIFTEENTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
51 SLEW DATA

140 s-h TABLE LIBRARY
141 SEVENTH RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
142 SEVENTH RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
143 SEVENTH RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 65]
FLOWCHART OF SEVENTH RECTANGULAR WAVEFORM SHAPING
1140 READ s-h TABLE
1141 READ SLEW DATA
1142 PERFORM RECTANGULAR WAVEFORM SHAPING LOOP
1143 EXTRACT

[FIG. 66]
c-h TABLE
IN THE CASE OF c=1.2

[FIG. 67]
BLOCK DIAGRAM SHOWING A CURRENT WAVEFORM CALCULATION SECTION
(SIXTEENTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
61 CAPACITANCE DATA
150 c-h TABLE LIBRARY
151 EIGHTH RECTANGULAR WAVEFORM HEIGHT CALCULATION SECTION
152 EIGHTH RECTANGULAR WAVEFORM WIDTH CALCULATION SECTION
153 EIGHTH RECTANGULAR WAVEFORM SHAPING SECTION

[FIG. 68]
FLOWCHART OF EIGHTH RECTANGULAR WAVEFORM SHAPING
1150 READ c-h TABLE
1151 READ CAPACITANCE DATA
1152 PERFORM RECTANGULAR WAVEFORM SHAPING LOOP
1143 EXTRACT

[FIG. 69]
TIME

[FIG. 70]
CURRENT
TIME

[FIG. 71]
CURRENT
TIME

[FIG. 72]
9001 CIRCUIT CONNECTION INFORMATION STORAGE MEANS
9002 PATTERN-OF-SIGNAL-CHANGE STORAGE MEANS
9003 ELEMENT CURRENT STORAGE MEANS
9004 TOTAL CURRENT STORAGE MEANS
9005 TOTAL CURRENT CALCULATION MEANS

[FIG. 74]
CURRENT
TIME

[FIG. 75]
CHANGED PINS
TIME
TOTAL CURRENT
PEAK CURRENT

[FIG. 76]
START ACTIVATION OF TOTAL CURRENT CALCULATION MEANS
9401 READ CIRCUIT CONNECTION INFORMATION
9402 READ PATTERN OF SIGNAL CHANGE
9403 READ INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING IN ELEMENT
9404 IMPART A PATTER OF SIGNAL CHANGE TO CIRCUIT CONNECTION

INFORMATION, TO THEREBY ENABLE PROPAGATION OF A SIGNAL. IN A CASE WHERE A CHANGE HAS ARISEN IN A SIGNAL APPEARING AT AN EXTERNAL INPUT TERMINAL OF A CIRCUIT ELEMENT, THE ELEMENT BEING DESCRIBED IN THE INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH AN ELEMENT, A RECTANGULAR WAVEFORM OF ELECTRIC CURRENT IS PRODUCED, BY MEANS OF AVERAGING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH THE EXTERNAL INPUT TERMINAL BY A PEAK VALUE. THE RECTANGULAR WAVEFORM IS ADDED TO THE INFORMATION CONCERNING THE TOTAL AMOUNT OF ELECTRIC CURRENT OBTAINED AT A TIME WHICH LAGS A PREDETERMINED PERIOD OF TIME FROM THE TIME A CHANGE HAS ARISEN IN THE EXTERNAL INPUT TERMINAL 9405 STORE, INTO TOTAL CURRENT STORAGE MEANS, TOTAL AMOUNT OF CURRENT OBTAINED AT EACH TIME
END OF OPERATION OF TOTAL CURRENT STORAGE MEANS

[FIG. 78]
LOGIC VALUE
TIME

[FIG. 79]
CURRENT
TIME

[FIG. 80]
CURRENT
TIME

[FIG. 81]
EDGE
CURRENT
PEAK VALUE

[FIG. 82]
CURRENT
TIME

[FIG. 83]
START ACTIVATION OF TOTAL CURRENT CALCULATION MEANS
10101 READ CIRCUIT CONNECTION INFORMATION
10102 READ PATTERN OF SIGNAL CHANGE
10103 READ INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING IN ELEMENT
10104 IMPART A PATTER OF SIGNAL CHANGE TO CIRCUIT CONNECTION INFORMATION, TO THEREBY ENABLE PROPAGATION OF A SIGNAL. IN A CASE WHERE A CHANGE HAS ARISEN IN A SIGNAL APPEARING AT AN EXTERNAL INPUT TERMINAL OF A CIRCUIT ELEMENT, THE ELEMENT BEING DESCRIBED IN THE INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH AN ELEMENT, A RECTANGULAR WAVEFORM OF AN ELECTRIC CURRENT IS PRODUCED BY MEANS OF AVERAGING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH THE EXTERNAL INPUT TERMINAL AT A RISE AND FALL OF THE SIGNAL BY MEANS OF A PEAK VALUE. THE RECTANGULAR WAVEFORMS ARE ADDED TO THE INFORMATION CONCERNING THE TOTAL AMOUNT OF ELECTRIC CURRENT OBTAINED AT A TIME WHEN THE CHANGE HAS ARISEN IN THE SIGNAL APPEARING AT THE EXTERNAL INPUT TERMINAL.
10105 STORE, INTO TOTAL CURRENT STORAGE MEANS, TOTAL AMOUNT OF CURRENT OBTAINED AT EACH TIME
END OF OPERATION OF TOTAL CURRENT STORAGE MEANS

[FIG. 85]
TIME

[FIG. 86]
CURRENT
TIME

[FIG. 87]
CURRENT
TIME

[FIG. 88]
NOR, Y-TERMINAL

TOTAL CURRENT AT LOGIC VALUE OF 1
PEAK CURRENT AT LOGIC VALUE OF 1
TOTAL CURRENT AT LOGIC VALUE OF 0
PEAK CURRENT AT LOGIC VALUE OF 0
TOTAL CURRENT AT LOGIC VALUE OF 1
PEAK CURRENT AT LOGIC VALUE OF 1
TOTAL CURRENT AT LOGIC VALUE OF 0
PEAK CURRENT AT LOGIC VALUE OF 0
TOTAL CURRENT AT LOGIC VALUE OF 1
PEAK CURRENT AT LOGIC VALUE OF 1
TOTAL CURRENT AT LOGIC VALUE OF 0
PEAK CURRENT AT LOGIC VALUE OF 0

[FIG. 89]

START ACTIVATION OF TOTAL CURRENT CALCULATION MEANS

10701 READ CIRCUIT CONNECTION INFORMATION

10702 READ PATTERN OF SIGNAL CHANGE

10703 READ INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING IN ELEMENT

10704 IMPART A PATTER OF SIGNAL CHANGE TO CIRCUIT CONNECTION INFORMATION, TO THEREBY ENABLE PROPAGATION OF A SIGNAL. IN A CASE WHERE A CHANGE HAS ARISEN IN A SIGNAL APPEARING AT AN EXTERNAL INPUT TERMINAL OF A CIRCUIT ELEMENT, THE ELEMENT BEING DESCRIBED IN THE INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH AN ELEMENT, A RECTANGULAR WAVEFORM OF AN ELECTRIC CURRENT IS PRODUCED BY MEANS OF AVERAGING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH THE EXTERNAL INPUT TERMINAL BY MEANS OF A PEAK VALUE IN ACCORDANCE WITH THE STATUS OF ANOTHER TERMINAL. THE RECTANGULAR WAVEFORM IS ADDED TO THE INFORMATION CONCERNING THE TOTAL AMOUNT OF ELECTRIC CURRENT OBTAINED AT A TIME WHEN THE CHANGE HAS ARISEN IN THE SIGNAL APPEARING AT THE EXTERNAL INPUT TERMINAL.

10705 STORE, INTO TOTAL CURRENT STORAGE MEANS, TOTAL AMOUNT OF CURRENT OBTAINED AT EACH TIME

END OF OPERATION OF TOTAL CURRENT STORAGE MEANS

[FIG. 90]

CURRENT

TIME

[FIG. 91]

1 NET LIST

2 TEST VECTOR

3 LIBRARY

4 LOGIC SIMULATOR

5 EVENT INFORMATION

6 SIMULATION RESULT

8 CALCULATION RESULT OF CURRENT WAVEFORM

9 FFT PROCESSING SECTION

10 RESULT OF EMI ANALYSIS

11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION

12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT

13 CURRENT WAVEFORM AVERAGING SECTION

A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE

A9 LAYOUT DATA

G2 CHARACTERIZATION

G3 I-V TABLE OR I-V FUNCTION FOR EACH CELL

G4 LINE VOLTAGE DROP CALCULATION/INSTANTANEOUSLY-CHANGING CURRENT CORRECTION SECTION

[FIG. 92]

12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT

A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE

A9 LAYOUT DATA

B1 INFORMATION CONCERNING INSTANTANEOUSLY-CHANGING CURRENT FOR EACH INSTANCE

B2 EXTRACTION OF POWER NET

B3 CALCULATION OF ELECTRIC CURRENT FLOWING IN EACH SEGMENT

B4 INFORMATION CONCERNING EACH SEGMENT IN POWER LINE

B5 INFORMATION CONCERNING ELECTRIC CURRENT OF EACH SEGMENT

B6 CALCULATION OF RESISTANCE OF EACH SEGMENT
B7 CALCULATION OF VOLTAGE DROP IN EACH SEGMENT
B8 INFORMATION CONCERNING RESISTANCE OF EACH SEGMENT
B9 INFORMATION CONCERNING VOLTAGE DROP IN EACH SEGMENT
B10 CALCULATION OF VOLTAGE DROP IN EACH INSTANCE
B11 INFORMATION CONCERNING VOLTAGE DROP IN EACH INSTANCE
H1 CORRECTION OF ELECTRIC CURRENT
G3 I-V TABLE OR I-V FUNCTION FOR EACH CELL

[FIG. 93]
1 NET LIST
2 TEST VECTOR
3 LIBRARY
4 LOGIC SIMULATOR
5 EVENT INFORMATION
6 SIMULATION RESULT
8 CALCULATION RESULT OF CURRENT WAVEFORM
9 FFT PROCESSING SECTION
10 RESULT OF EMI ANALYSIS
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
13 CURRENT WAVEFORM AVERAGING SECTION
A9 LAYOUT DATA
I1 CHARACTERIZATION
I2 I-C-H TABLE OR I-C-H FUNCTION FOR EACH CELL
I3 LINE VOLTAGE DROP CALCULATION/INSTANTANEOUSLY-CHANGING CURRENT CORRECTION SECTION

[FIG. 94]
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
A6 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT TAKING INTO CONSIDERATION A DROP IN LINE VOLTAGE
A9 LAYOUT DATA
B1 INFORMATION CONCERNING INSTANTANEOUSLY-CHANGING CURRENT FOR EACH INSTANCE
B2 EXTRACTION OF POWER NET

B3 CALCULATION OF ELECTRIC CURRENT FLOWING IN EACH SEGMENT
B4 INFORMATION CONCERNING EACH SEGMENT IN POWER LINE
B5 INFORMATION CONCERNING ELECTRIC CURRENT OF EACH SEGMENT
B6 CALCULATION OF RESISTANCE OF EACH SEGMENT
B8 INFORMATION CONCERNING RESISTANCE OF EACH SEGMENT
B9 INFORMATION CONCERNING VOLTAGE DROP IN EACH SEGMENT
B10 CALCULATION OF VOLTAGE DROP IN EACH INSTANCE
B11 INFORMATION CONCERNING VOLTAGE DROP IN EACH INSTANCE
J1 CORRECTION OF ELECTRIC CURRENT
I2 I-C-V TABLE OR I-C-V FUNCTION FOR EACH CELL
D1 CALCULATION OF CAPACITANCE PROVIDED BETWEEN SEGMENTS
D2 INFORMATION CONCERNING A CAPACITANCE PROVIDED BETWEEN SEGMENTS

[FIG. 95]
1 NET LIST
2 TEST VECTOR
3 LIBRARY
4 LOGIC SIMULATOR
5 EVENT INFORMATION
6 SIMULATION RESULT
8 CALCULATION RESULT OF CURRENT WAVEFORM
9 FFT PROCESSING SECTION
10 RESULT OF EMI ANALYSIS
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
13 CURRENT WAVEFORM AVERAGING SECTION
A9 LAYOUT DATA
A10 I-V TABLE OR I-V FUNCTION FOR EACH CELL
A11 LINE VOLTAGE DROP CALCULATION/INSTANTANEOUSLY-CHANGING CURRENT CORRECTION SECTION
K1 COMPARISON/DETERMINATION

[FIG. 96]
TRIANGULAR WAVEFORM MODEL (TWENTY-THIRD EMBODIMENT)

[FIG. 97]
BLOCK DIAGRAM SHOWING CALCULATION OF A CURRENT WAVEFORM (TWENTY-THIRD EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
130 PEAK CURRENT LIBRARY
160 TRIANGULAR WAVEFORM HEIGHT CALCULATION SECTION
161 TRIANGULAR WAVEFORM WIDTH CALCULATION SECTION
162 TRIANGULAR WAVEFORM SHAPING SECTION

[FIG. 98]
FLOWCHART OF TRIANGULAR WAVEFORM SHAPING
1150 READ PEAK CURRENT LIBRARY
1161 PERFORM TRIANGULAR WAVEFORM SHAPING LOOP
1162 EXTRACT HEIGHT OF TRIANGULAR WAVEFORM OF OBJECT INSTANCE FROM PEAK CURRENT LIBRARY

[FIG. 99]
MULTI-ORDER-FUNCTION MODEL (TWENTY-FOURTH EMBODIMENT)

[FIG. 100]
BLOCK DIAGRAM SHOWING CALCULATION OF A CURRENT WAVEFORM (TWENTY-FOURTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
130 PEAK CURRENT LIBRARY
170 MULTI-ORDER-FUNCTION WAVEFORM HEIGHT CALCULATION SECTION
171 MULTI-ORDER-FUNCTION WAVEFORM WIDTH CALCULATION SECTION
172 MULTI-ORDER-FUNCTION WAVEFORM SHAPING SECTION

[FIG. 101]
FLOWCHART OF MULTI-ORDER-FUNCTION WAVEFORM SHAPING
1170 READ PEAK CURRENT LIBRARY
1171 PERFORM MULTI-ORDER-FUNCTION WAVEFORM SHAPING LOOP
1172 EXTRACT HEIGHT OF TRIANGULAR WAVEFORM OF OBJECT INSTANCE FROM PEAK CURRENT LIBRARY

[FIG. 102]
BLOCK DIAGRAM SHOWING CALCULATION OF A CURRENT WAVEFORM (TWENTY-FIFTH EMBODIMENT)
3 LIBRARY
5 EVENT INFORMATION
8 CALCULATION RESULT OF CURRENT WAVEFORM
11 INSTANTANEOUSLY-CHANGING CURRENT CALCULATION SECTION
12 CALCULATION RESULT OF INSTANTANEOUSLY-CHANGING CURRENT
130 PEAK CURRENT LIBRARY
181 WIDTH LIBRARY
180 GAUSSIAN FUNCTION WAVEFORM HEIGHT CALCULATION SECTION
182 GAUSSIAN FUNCTION WAVEFORM WIDTH CALCULATION SECTION
183 GAUSSIAN FUNCTION WAVEFORM SHAPING SECTION

[FIG. 103]
FLOWCHART OF GAUSSIAN FUNCTION WAVEFORM SHAPING
1180 READ PEAK CURRENT LIBRARY
1181 READ WIDTH LIBRARY
1182 PERFORM GAUSSIAN FUNCTION WAVEFORM SHAPING LOOP
1183 EXTRACT HEIGHT OF TRIANGULAR WAVEFORM OF OBJECT INSTANCE FROM PEAK CURRENT LIBRARY
1184 EXTRACT WIDTH OF OBJECT INSTANCE FROM WIDTH LIBARRY

[FIG. 104]
CURRENT
TIME

[FIG. 105]
FLIP-FLOP FF/Q

TOTAL SHORT CIRCUIT CURRENT
PEAK VALUE OF SHORT CIRCUIT CURRENT
TOTAL CHARGE CURRENT
PEAK VALUE OF CHARGE CURRENT

FLIP-FLOP FF/CK
TOTAL SHORT CIRCUIT CURRENT
PEAK VALUE OF SHORT CIRCUIT CURRENT
TOTAL CHARGE CURRENT
PEAK VALUE OF CHARGE CURRENT

BUFFER BUF/Y
TOTAL SHORT CIRCUIT CURRENT
PEAK VALUE OF SHORT CIRCUIT CURRENT
TOTAL CHARGE CURRENT
PEAK VALUE OF CHARGE CURRENT

[FIG. 106]
CURRENT
TIME

[FIG. 107]
START ACTIVATION OF TOTAL CURRENT CALCULATION MEANS
12501 READ CIRCUIT CONNECTION INFORMATION
12502 READ PATTERN OF SIGNAL CHANGE
12503 READ INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING IN ELEMENT
12504 IMPART A PATTER OF SIGNAL CHANGE TO CIRCUIT CONNECTION INFORMATION, TO THEREBY ENABLE PROPAGATION OF A SIGNAL. IN A CASE WHERE A CHANGE HAS ARISEN IN A SIGNAL APPEARING AT AN EXTERNAL INPUT TERMINAL OF A CIRCUIT ELEMENT, THE ELEMENT BEING DESCRIBED IN THE INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH AN ELEMENT, A RECTANGULAR WAVEFORM OF AN ELECTRIC CURRENT IS PRODUCED BY MEANS OF AVERAGING SHORT CIRCUIT CURRENT OF THE ELECTRIC CURRENT BY MEANS OF A PEAK VALUE THEREOF. A RECTANGULAR WAVEFORM OF AN ELECTRIC CURRENT IS

PRODUCED BY MEANS OF AVERAGING CHARGE CURRENT OF THE ELECTRIC CURRENT BY MEANS OF A PEAK CURRENT THEREOF. THE RECTANGULAR WAVEFORMS ARE ADDED TO THE INFORMATION CONCERNING THE TOTAL AMOUNT OF ELECTRIC CURRENT OBTAINED AT A TIME WHEN THE CHANGE HAS ARISEN IN THE SIGNAL APPEARING AT THE EXTERNAL INPUT TERMINAL.

12505 STORE, INTO TOTAL CURRENT STORAGE MEANS, TOTAL AMOUNT OF CURRENT OBTAINED AT EACH TIME

END OF OPERATION OF TOTAL CURRENT STORAGE MEANS

[FIG. 109]

1001 CIRCUIT CONNECTION INFORMATION STORAGE MEANS

1002 PATTERN-OF-SIGNAL-CHANGE STORAGE MEANS

1003 ELEMENT CURRENT STORAGE MEANS

1004 TOTAL CURRENT STORAGE MEANS

1005 TOTAL CURRENT CALCULATION MEANS

[FIG. 111]

TIME

[FIG. 112]

FLIP-FLOP FF

THE AMOUNT OF CURRENT FLOWING WHEN Y IS CHANGED

THE AMOUNT OF CURRENT FLOWING WHEN CK IS CHANGED

BUFFER BUF

THE AMOUNT OF CURRENT FLOWING WHEN Y IS CHANGED

[FIG. 113]

TOTAL CURRENT

TIME

[FIG. 114]

START ACTIVATION OF TOTAL CURRENT CALCULATION MEANS

1501 READ CIRCUIT CONNECTION INFORMATION

1502 READ PATTERN OF SIGNAL CHANGE

1503 READ INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING IN ELEMENT

1504 IMPART A PATTER OF SIGNAL CHANGE TO CIRCUIT CONNECTION INFORMATION, TO THEREBY ENABLE PROPAGATION OF A SIGNAL. IN A CASE WHERE A CHANGE HAS ARISEN IN A SIGNAL APPEARING AT AN EXTERNAL INPUT TERMINAL OF A CIRCUIT ELEMENT, THE ELEMENT BEING DESCRIBED IN THE INFORMATION CONCERNING THE AMOUNT OF ELECTRIC CURRENT FLOWING THROUGH AN ELEMENT, THE AMOUNT OF CURRENT APPEARING AT THE CIRCUIT ELEMENT IS ADDED TO THE INFORMATION CONCERNING THE TOTAL AMOUNT OF ELECTRIC CURRENT OBTAINED AT EACH TIME.

1505 STORE, INTO TOTAL CURRENT STORAGE MEANS, TOTAL AMOUNT OF CURRENT OBTAINED AT EACH TIME

END OF OPERATION OF TOTAL CURRENT STORAGE MEANS

[FIG. 115]

TIME

[FIG. 116]

O1 LAYOUT DATA

O2 LPE RULE

O3 LPE PROCESSING

O4 NET LIST

O5 TEST PATTERN

O6 SWITCH-SCALE CIRCUIT SIMULATION

O7 CURRENT WAVEFORM OF EACH TRANSISTOR

O8 MODELING OF CURRENT SOURCE

O9 MODELING OF CURRENT SOURCE ELEMENT

O10 LPE PROCESSING OF POWER LINE

O11 POWER LINE NET LIST

O12 TRANSIENT ANALYSIS SIMULATION

O13 RESULT OF CURRENT WAVEFORM

O14 FFT PROCESSING

O15 RESULT OF EMI ANALYSIS

O16 WIRE-LEAD FRAME IMPEDANCE

[FIG. 117A]
LOGIC VALUE
TIME

[FIG. 117B]
CURRENT
h = CURRENT (I) X 2/OUTPUT SLEW (W)
OUTPUT SLEW (W)
TIME

[FIG. 118]
1171 PATTERN-OF-SIGNAL-CHANGE STORAGE MEANS
1172 ELEMENT CURRENT STORAGE MEANS
1173 OUTPUT SLEW INFORMATION STORAGE MEANS
1174 CIRCUIT CONNECTION INFORMATION STORAGE MEANS
1175 CURRENT WAVEFORM CALCULATION MEANS
1176 CALCULATION RESULT OF CURRENT WAVEFORM

[FIG. 119]
FLOWCHART OF CALCULATION OF CURRENT WAVEFORM
1190 READ OUTPUT SLEW
1191 PERFORM TRIANGULAR WAVEFORM SHAPING LOOP
1192 EXTRACT BASE OF TRIANGULAR WAVE FROM OBJECT INSTANCE FROM OUTPUT SLEW

[FIG. 120A]
LOGIC VALUE
OUTPUT
TIME

[FIG. 120B]
CURRENT
TIME
OUTPUT SLEW
CURRENT (I) X 2 X RISE-DEPENDENT COEFFICIENT/OUTPUT SLEW (W)
CURRENT (I) X 2 X FALL-DEPENDENT COEFFICIENT/OUTPUT SLEW (W)

FALL-DEPENDENT COEFFICIENT = 2 - RISE-DEPENDENT COEFFICIENT

[FIG. 121]
1201 PATTERN-OF-SIGNAL-CHANGE STORAGE MEANS
1202 ELEMENT CURRENT STORAGE MEANS
1203 OUTPUT SLEW INFORMATION STORAGE MEANS
1204 CIRCUIT CONNECTION INFORMATION STORAGE MEANS
1205 CURRENT WAVEFORM CALCULATION MEANS
1206 CURRENT WAVEFORM STORAGE MEANS
1207 RISE-DEPENDENT COEFFICIENT/FALL-DEPENDENT COEFFICIENT STORAGE MEANS

[FIG. 122A]
LOGIC VALUE, DELAY
INPUT
OUTPUT
TIME

[FIG. 122B]
CURRENT
TIME
(CURRENT - CURRENT WHICH IS NOT DEPENDENT ON OUTPUT LOAD)X 2/OUTPUT SLEW
CURRENT WHICH IS NOT DEPENDENT ON OUTPUT LOAD X 2 / (DELAY - OUTPUT SLEW/2)
(DELAY - OUTPUT SLEW/2)/(NUMBER OF STAGES -1)
OUTPUT SLEW
TIME

[FIG. 123]
SLEW/CAPACITANCE CALCULATION MEANS
OUTPUT LOAD CAPACITANCE INFORMATION STORAGE MEANS
INPUT SLEW INFORMATION STORAGE MEANS
1221 PATTERN-OF-SIGNAL-CHANGE STORAGE MEANS
1222 ELEMENT CURRENT STORAGE MEANS
1223 OUTPUT SLEW INFORMATION STORAGE MEANS

1224 CIRCUIT CONNECTION INFORMATION STORAGE MEANS

1225 CURRENT WAVEFORM CALCULATION MEANS

1226 CURRENT WAVEFORM STORAGE MEANS

1227 ELEMENT CURRENT CALCULATION MEANS

1228 NON-LOAD ELEMENT CURRENT STORAGE MEANS

1229 NUMBER-OF-STAGES STORAGE MEANS